MAY • 1953
PRICE 35 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

NISA PLANNERS *Prise, Engelmann and Griffith, prepare program for New York convention.*

SPECIALIZED CONTROL *hookups are important part of electrical operations in Cleveland plant.*

SUPER-LIGHTING *for superhighway project skirting Chicago's northern suburbs.*

A McGRAW-HILL PUBLICATION | 52ND YEAR

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

COMPACT CAPACITOR INSTALLATION in the Halle Bros. Company, Shaker Square store, Cleveland, Ohio, is inspected by Mr. W. L. Smith, store engineer

Saves $800 a year on a $620 capacitor investment

Halle Bros. Co. cuts power costs 19% improves power factor 20% with G-E capacitors

An installation of General Electric capacitors produced these results in the Shaker Square Branch store of Halle Bros. Company, Cleveland, Ohio, according to Milton Beyer, Building Superintendent.

Serious power losses were encountered prior to installing capacitors because of low power factor air-conditioning motor loads. In addition, a kva-demand clause in their power contract was penalizing the Company for poor power factor.

SAVINGS EFFECTED. Since installing G-E capacitors, there has been a reduction of from 18% to 20% in the total power bill. Power factor has been increased more than 20%, from 71.6% to better than 95%.

CAPACITORS PAID FOR IN 6 MONTHS. In the first six months, the capacitors saved the Halle Bros. Company more than $600. Since the total installed cost of the G-E capacitor equipment was only $620, it paid for itself in less than a year. But the savings won't stop here. As superintendent Milton Beyer puts it, "We expect to save about $800 a year from now on."

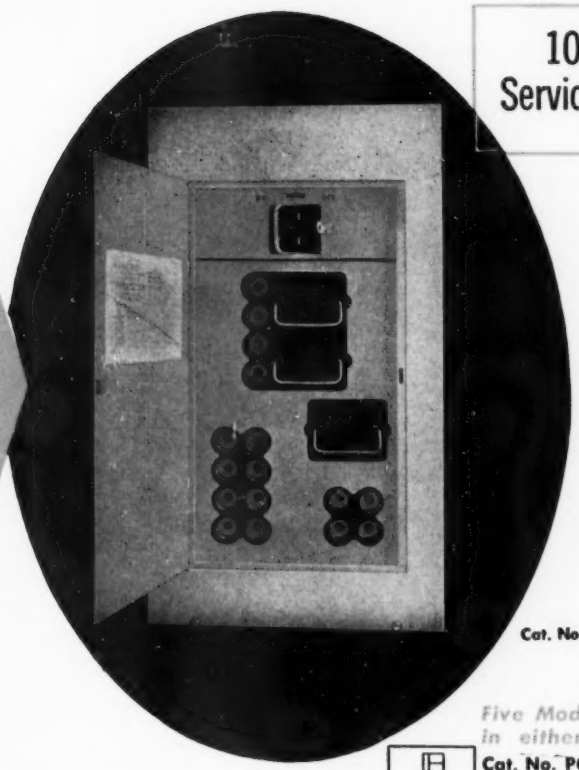
KEY TO LOWER POWER COSTS. If your power factor is below 90% and if there is a kva-demand or power-factor clause in your power contract, chances are you, too, can make worthwhile savings on your power costs by installing G-E capacitors. For additional information, consult your nearest G-E Apparatus Sales Office, or authorized agent or distributor. Or write to Section 441-102 for Booklet GEA-5632—"How to Use Capacitors to Reduce Power Costs." General Electric Company, Schenectady 5, New York. 441-102

You can put your confidence in—

GENERAL ELECTRIC

ANOTHER NEW Murray PRODUCT

100 Ampere Service Equipment



Cat. No. PC316A

HERE'S A "Packaged" SOLUTION TO INCREASING LOADS

Murray's "Combination" units will solve your main switch and distribution panel problems—

1 THEY PROVIDE BOTH SERVICE ENTRANCE AND BRANCH DISTRIBUTION IN ONE UNIT.

These Murray "Combination" service entrance and branch distribution units provide 100 Ampere main circuit breaker, fusible range and water heater pullouts, lighting and appliance plug fuse branch circuits—with or without a dryer pullout!

2 THEY PROVIDE FOR GROWING ELECTRICAL LOADS.

Any one of these five compact units offers a packaged solution to increasing loads. They are ideal for small commercial and large residential installations.

3 THEY SAVE TIME AND MONEY IN INSTALLATION.

Murray "Combination" units will save you time and money all along the line. Just one unit to *buy* — just one unit to *install* — just one unit to *wire*!

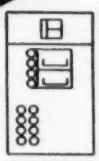
Factory bussing makes these units easy to wire. There's plenty of wiring room and all K. O's are conveniently located. Hook-on cover uses only two screws. Compact! Only 12-⅞ inches wide, designed to fit between building studs.

4 THEY GIVE DEPENDABLE CIRCUIT PROTECTION AT ALL TIMES.

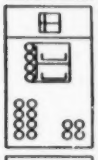
Fully magnetic circuit breaker main consists of two independent trip, 1 pole, 100 Ampere 120/240 volt AC fully magnetic circuit breakers. Carries full rated load continuously. Handle bar permits simultaneous manual tripping to "off".

Murray's well-known fusible pull-out construction provides positive electrical contact. One piece fuse clip and blade prevents overheating.

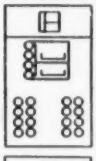
Five Models to Choose from in either surface or flush.



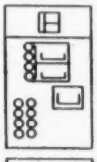
Cat. No. PC212A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
12 plug fuse branch circuits
List Price — **$59.00**



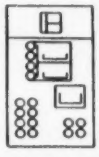
Cat. No. PC216A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
16 plug fuse branch circuits
List Price — **$69.00**



Cat. No. PC220A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
20 plug fuse branch circuits
List Price — **$80.00**



Cat. No. PC312A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
12 plug fuse branch circuits
List Price — **$69.00**



Cat. No. PC316A
100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
16 plug fuse branch circuits
List Price — **$76.00**

Write for full information to:

Murray®

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE • BROOKLYN 16, N.Y.

Service Entrance & Meter Equipment • Fully Magnetic Circuit Breakers • Switches (Types A, C and D)
Current Limiting Reactors • Crows' Nest Aerial Ladders

Better Play SAFE

Type ARTC Explosion-Proof Tumbler Switch Unilet. Made of unbreakable MALLEABLE IRON, light and strong.

Protect all Hazardous Locations with APPLETON EXPLOSION-PROOF EQUIPMENT

AA-51 Series Vented Type Explosion-Proof lighting fixture. Cooler operating ... easier to service.

It's a comfortable feeling to know that all hazardous locations in your plant have Appleton *positive protection* against fire or explosion from electrical causes.

Appleton Explosion-Proof Equipment *confines* all short circuits, switch arcs, flames or explosions *within* the switch box, conduit fitting or fixture. All threaded connections have five full threads to imprison flames or arcs, and to cool escaping gases after an internal explosion has occurred. Flat joints at cover openings are accurately machined for flame-tightness, and have extra screws for added strength.

Unbreakable malleable iron gives extra strength and lightness. Appleton Explosion-Proof fittings withstand at least *four times* the maximum possible internal pressures without bursting or loosening screws or joints.

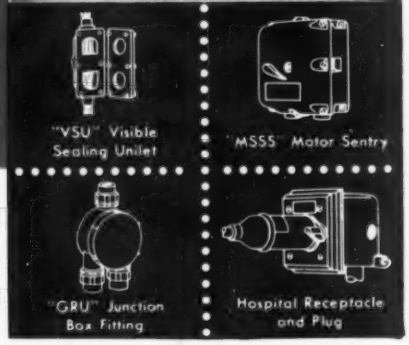
All Appleton Explosion-Proof Equipment meets the requirements of Class I, Groups C and D, hazardous locations. Write for details.

Type EFU Explosion-Proof fluorescent lighting fixture. Available for two 40 Watt, 48" lamps; or two 100 Watt, 60" lamps.

Type FSQX Explosion-Proof and Dust-Tight plug and receptacle with interlocking safety switch.

APPLETON MALLEABLE -IRON- UNILETS

There Are APPLETON Explosion-Proof Fittings for Every Requirement



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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WHAT *Life-Line* REALLY DELIVERS IS MORE SERVICE...LESS SERVICING

"Whips Trouble Spots" Say users of these *Life-Lines*

"Neither Vibration Nor Moisture Are Problems Now," says the Richard Ore Co. "We installed 7 Westinghouse Life-Linestarters® in a particularly difficult application, a mine concentrating mill. We were off to a flying start immediately—the Westinghouse Life-Linestarter is easier to install because of straight-through wiring and the arrangement of breaker and starter in a single enclosure. Outages due to moisture and vibration have been virtually eliminated. That had been our biggest headache . . . more Life-Lines will be installed shortly."

"No Motor Failures of Any Kind, Now," says Watchcase Manufacturer. "Our punch-press motors were 14 feet off the floor . . . just high enough so that lubrication was often 'forgotten'. Frequent bearing failures and burnouts resulted until we 'perched' pre-lubricated Life-Lines up there two years ago. Since then . . . no failures of any kind. We've standardized on Life-Lines."

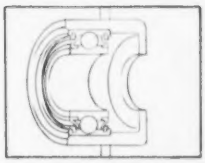
"Straight-Through Wiring Answered My Problem," says the Baker Refrigeration Corp. "We have a new air-conditioning design that requires the use of two starters. We found that the Westinghouse Life-Linestarter could be more easily mounted in a group within our enclosure—saved assembly labor. This completely sold me on your straight-through wiring."

"Increase Bearing Life 8 Times," says Oak Hill Firebrick Co. "We were using sleeve-bearing motors on a shaker screen in a firebrick plant. Bearings never lasted over six months. Life-Lines installed over four years ago have been running 16 hours a day ever since. Pre-lubricated bearings have been perfect."

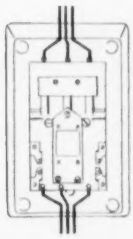
Typical? Yes. Typical of hundreds of reports in every industry. Why not install these dependable partners on your machines? A check with your Westinghouse representative will bring you full details. Ask for copies of "Life-Line Motor Case History Book", B-4769-A and "Tomorrow's Starter Today", B-4677, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21697-A

YOU CAN BE **SURE**...IF IT'S

Westinghouse

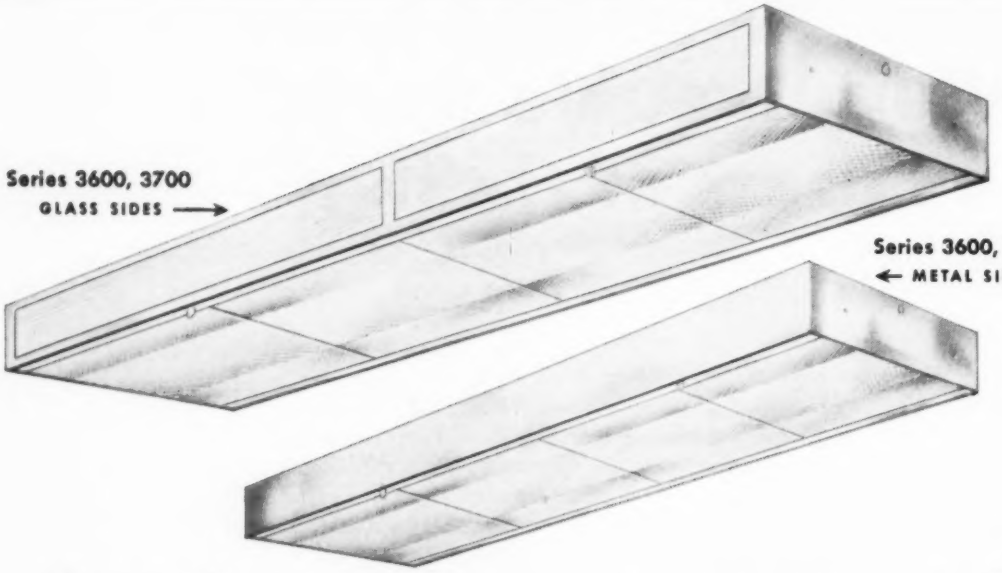


Needs no lubrication. Pre-lubricated, factory-sealed bearings eliminate troubles due to under or overlubrication, dust and dirt.



Straight-through wiring. Three line terminals at top; three load terminals at bottom—all easily reached from front.

Bonderite-protected starter enclosure. Anchors enamel as if it were part of steel itself. Finish will not blister or corrode.



Another Litecontrol First!*

Fixtures that make Work Light

These LITECONTROL "surface troffer" fixtures combine comfortable lighting levels with new ease of installation and maintenance.

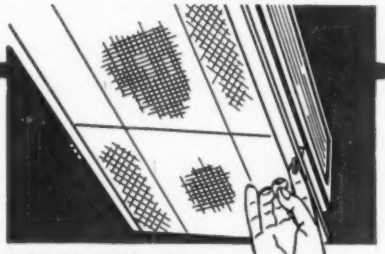
Lenses are set in hinged doors, equipped with LITECONTROL *Trigger Catches.* Absence of visible dividers between doors provides attractive, unbroken length of lenses.

Models 3600 through 3700 have glass side panels. Reduce contrast between ceiling and fixture with upward illumination.

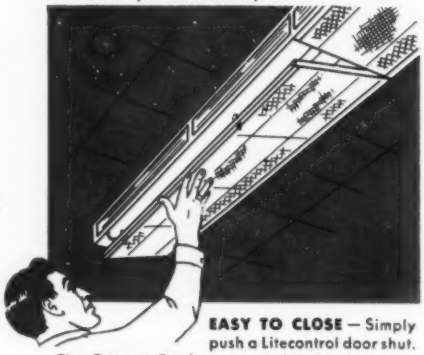
Extremely shallow, economical, easy to open and close, they make a smart choice for offices, banks and stores.

Get the full time-and-money-saving story on LITECONTROL'S complete line of fixtures. Write, today.

CAT. NO.	NO. OF LAMPS	SIDES
3624	2-40W Bipin	Glass
3724	2-48T12 Slimline	Glass
3728	2-96T12 Slimline	Glass
3824	2-40W Bipin	Metal
3924	2-48T12 Slimline	Metal
3928	2-96T12 Slimline	Metal



EASY TO OPEN — Just a touch on the *Triggers*, and a Litecontrol door conveniently opens. No screws or adjustments of any kind necessary.



EASY TO CLOSE — Simply push a Litecontrol door shut. The *Trigger Catch* snaps and holds instantly, safely, dependably

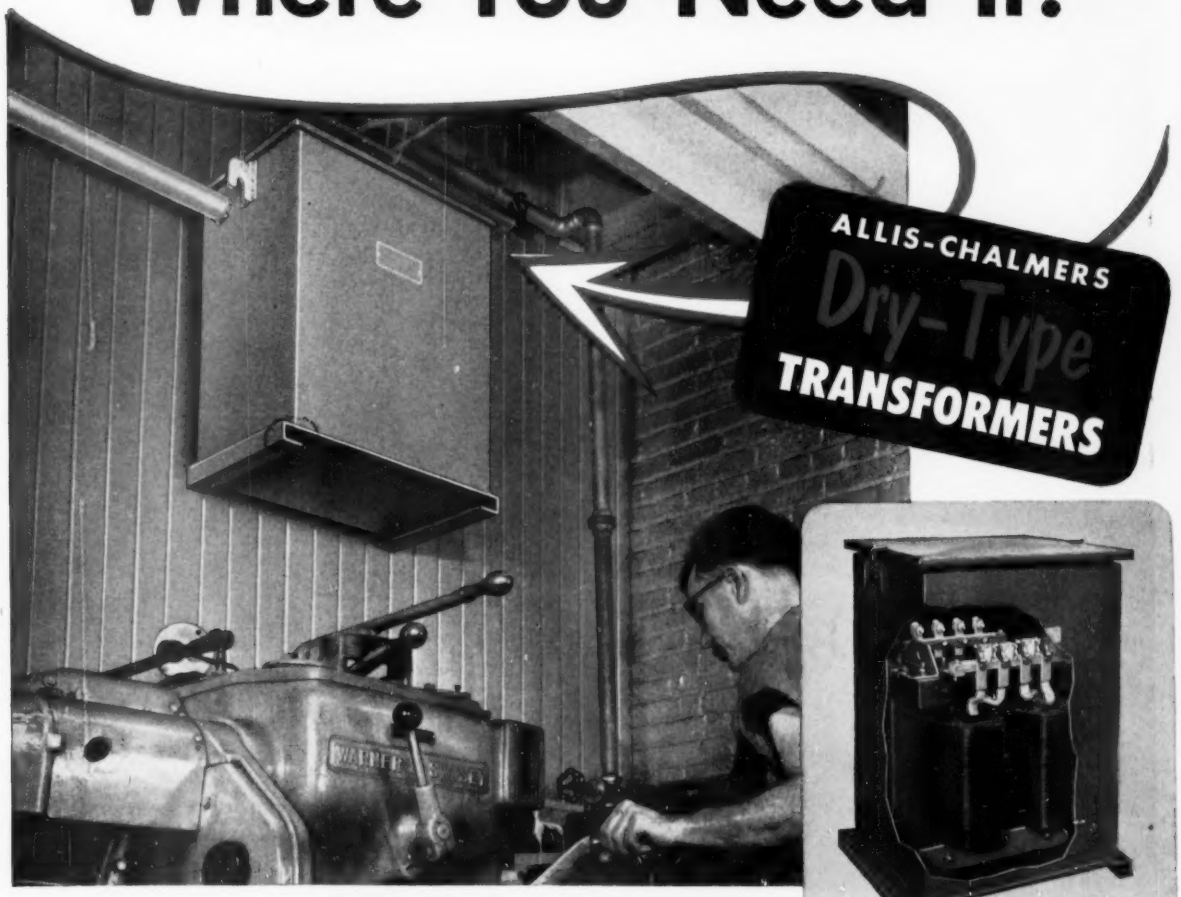
LITECONTROL
Fixtures

LITECONTROL CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

PUT POWER Where You Need It!



HERE'S THE WAY to assure rated voltage for motors and other equipment. Install Allis-Chalmers dry-type transformers close to the load to provide full voltage for efficient motor operation, flicker-free lights, and full heating of thermal equipment.

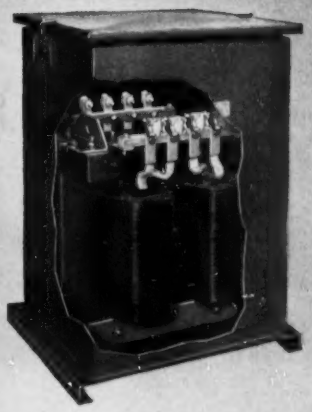
You can mount them anywhere, on posts, beams or walls, in a small amount of space, or right on the machine itself. You don't need vaults or expensive enclosures.

Installation is easy because junction boxes are eliminated. Knockouts are provided for connecting conduits directly to the transformer case. System cables are connected to the transformer terminals in compartments.

Maintenance is easy, too. You install Allis-Chalmers transformers and forget them except for periodic inspections. There are no insulating liquids to maintain; no gauges or gaskets to fuss with.

Get more information from your Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3980

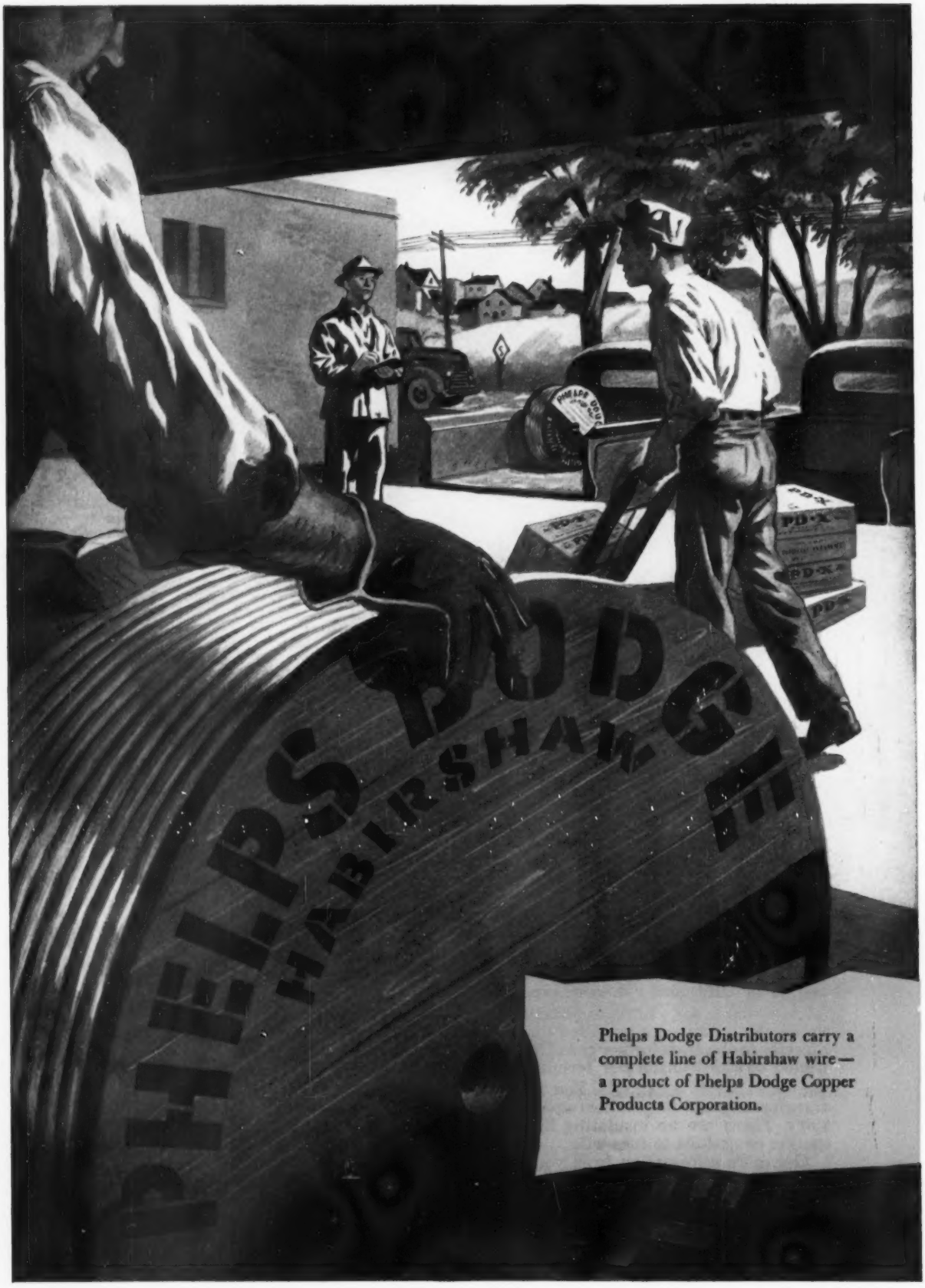


IT'S ENDURANCE BUILT

Core and coil assembly is impregnated to guard against moisture and dirt. All-welded, modern looking case protects the internal assembly. Case is Spra-Bonderized to protect it against corrosion. Three coats of baked-on alkyd resinous paint furnish additional protection.

Ratings 167 kva and smaller (single phase); 300 kva and smaller (three phase); 600 volts and below.

ALLIS-CHALMERS



Phelps Dodge Distributors carry a complete line of Habirshaw wire—a product of Phelps Dodge Copper Products Corporation.

SEE YOUR PHELPS DODGE DISTRIBUTOR FOR

QUALITY and SERVICE

THAT SIMPLIFY YOUR JOB!

It's easier to maintain a reputation for the highest quality materials, the most dependable job performance, when you rely on a Phelps Dodge Distributor for your wire requirements.

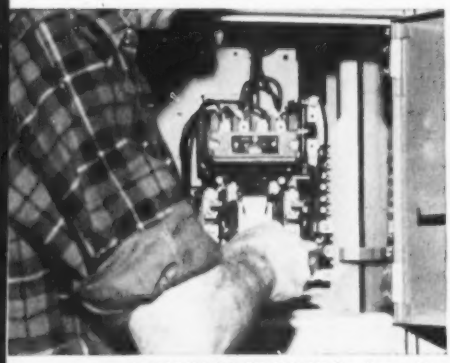
Your distributor's personal background of experience is backed by Phelps Dodge's engineering "know-how" which is available when needed.

PHELPS DODGE COPPER PRODUCTS CORPORATION

WIRE BY PHELPS DODGE MEANS WIRED FOR LIFE!

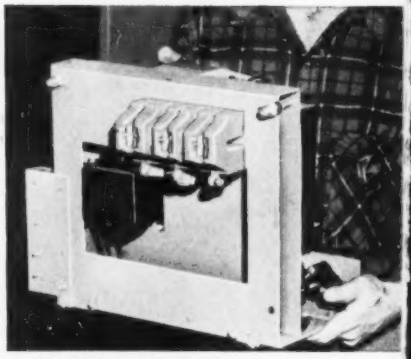
ENGINEERED FOR YOU, the new G-E motor control center is the result of intensive field surveys which told us what industry wants most. It provides maximum flexibility (units easily interchangeable) for central control of a-c motors up to 200 horsepower.

Here are Six Reasons for Specifying the New G-E Motor Control Center

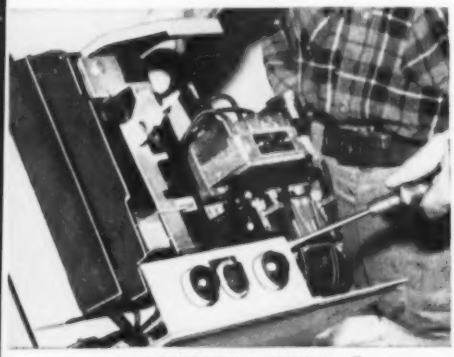


1 FOUR-INCH TROUGH for incoming power lines; terminals in front for easy wiring, maximum accessibility.

2 UNITS EASY TO CHANGE. To remove, disconnect terminals, pull unit out. Units easily changed since *all* components are on unit frame.



3 LIGHTWEIGHT UNITS are compact and easy to handle. This Size 1 starter unit weighs only 30 pounds.



4 ACCESSIBILE WIRING. Contactors, relays, pushbuttons, and breaker are easily accessible from all four sides.

5 BUS PROTECTED. Steel barrier keeps personnel away from bus. For added safety, compartment doors can be closed while unit is out of compartment.

6 DISCONNECT POSITION cuts unit power off; bus connections made automatically in operating position.

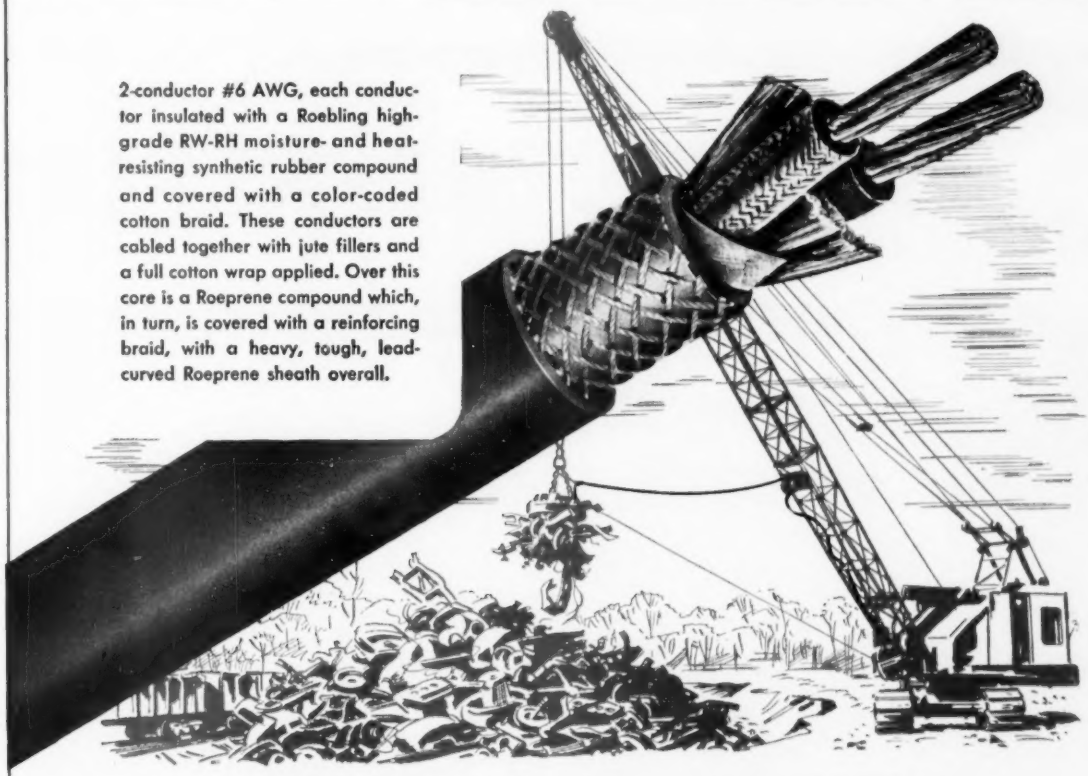
FOR FURTHER INFORMATION, contact your nearest G-E Apparatus Sales Office or authorized G-E distributor, or write Section 781-2 for Bulletin GEA-4979A today. General Electric Company, Schenectady, New York.

You can put your confidence in—

GENERAL ELECTRIC

ROECLAD PORTABLE POWER CABLES

2-conductor #6 AWG, each conductor insulated with a Roebling high-grade RW-RH moisture- and heat-resisting synthetic rubber compound and covered with a color-coded cotton braid. These conductors are cabled together with jute fillers and a full cotton wrap applied. Over this core is a Roeprene compound which, in turn, is covered with a reinforcing braid, with a heavy, tough, lead-curved Roeprene sheath overall.



Roebling Roeclad Lifting Magnet Cables outlast all others 2 to 1

Roebling Roeclad Lifting Magnet Cable is engineered and produced to withstand rough treatment and to give long service life. The design of this cable is based on field experience of more than 30 years.

Exhaustive tests performed in Roebling laboratories to prove the superiority of Roeclad Lifting Magnet Cables included fatigue and impact tests of representative samples.

In a fatigue test, cable samples after being subjected to more than 2,000,000 reversals—half at room temperature and half at 0°F.—showed no damage to either of the two conductors.

In impact tests, it required over 3000 blows of a 20-lb. weight dropped 5½ inches, 25 times per minute, to cause failure of a two-conductor #8 AWG Roeclad Lifting Magnet Cable.

And a report from an engineering company which has a large number of machines equipped with magnets is typical of the entire field... that Roeclad Lifting Magnet Cable out-performs competitive cables by at least 2 to 1.

Through unending research and development, Roebling's complete electrical line is constantly being improved. You can always buy Roebling with assurance of top efficiency and economy. John A. Roebling's Sons Corporation, Trenton 2, N. J.

Subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING

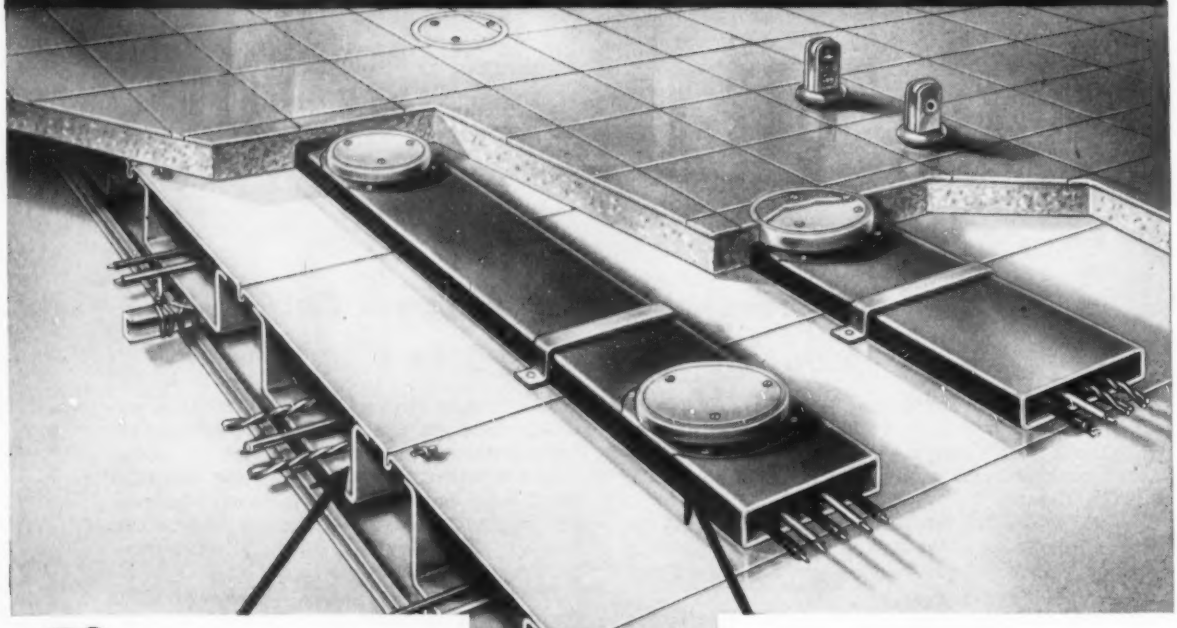
ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST & 5 PITTSBURGH ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST & 120 S. HEWITT ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • PITTSBURGH, 1301 CLARK BLDG • ROCHESTER, 1 FLINT ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • ST. LOUIS, 3001 DELMAR BLVD • TULSA, 321 N. CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, NEW JERSEY

CF&I

New expanding market for energized <u>new</u> sales opportunities

Announcing **FENESTRA-NEPCO**

The NEW ELECTRIFIED cellular floor system



Fenestra FLOOR PANELS by Detroit Steel Products Company

The cellular steel load-supporting structural panels couple maximum strength with light weight . . . offer maximum cross sectional area (30 sq. inches) for wire fills. Cellular raceways are used for installation of electrical wires for power, light, telephone, and intercommunications.

ENERGIZED with NEPCO Header Duct Wiring System

National Electric Header Duct is an all-steel grounded feeder raceway from the distribution panel to the raceways formed by the structural steel floor panels. Electric wiring through this combined raceway system provides the availability of electric outlets in any square foot of floor area.

floors means for electrical contractors

ELECTRIFLOOR

In line with National Electric's position as a single source of supply for *everything in wiring,* we are pleased to announce to the electrical trade the *new* Fenestra-Nepco Electrifloor, the latest development in cellular steel electrified flooring.

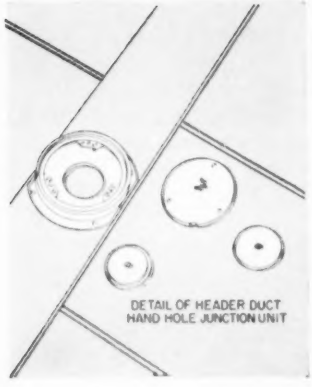
Now, two leading manufacturers—Detroit Steel Products Company and National Electric Products Corporation—have combined their engineering know-how in the development of an electrical floor distribution system utilizing the large area ducts of cellular building panels.

NOW **You are no longer limited to one supplier for this type of wiring system.**

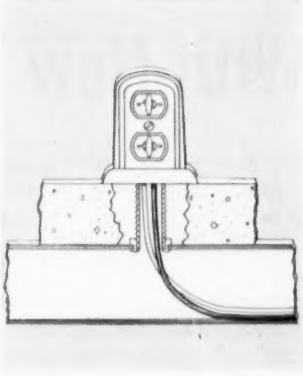
NOW **You are a greater factor in the design of the building.**

NOW **You can purchase from your favorite National Electric distributor.**

HERE'S HOW ELECTRIFLOOR WORKS:



1. Header duct is installed on top of cellular steel panels according to pre-determined layout. Access holes are used to feed the panel cells selected for electrification.
2. Electrical service fittings are installed as specified in office layout. Service fittings may be established anywhere along the cellular raceway.
3. Selected raceways or all raceways may be energized to accommodate any requirements of power, light, telephone or inter-communications.
4. Cellular raceways may be energized when header duct is installed or at a later date. Service extensions or relocations can be made easily, in less time than ever before, with less interruption to office routine.



Listed and approved by Underwriters' Laboratories, Inc. Sold through leading electrical distributors.

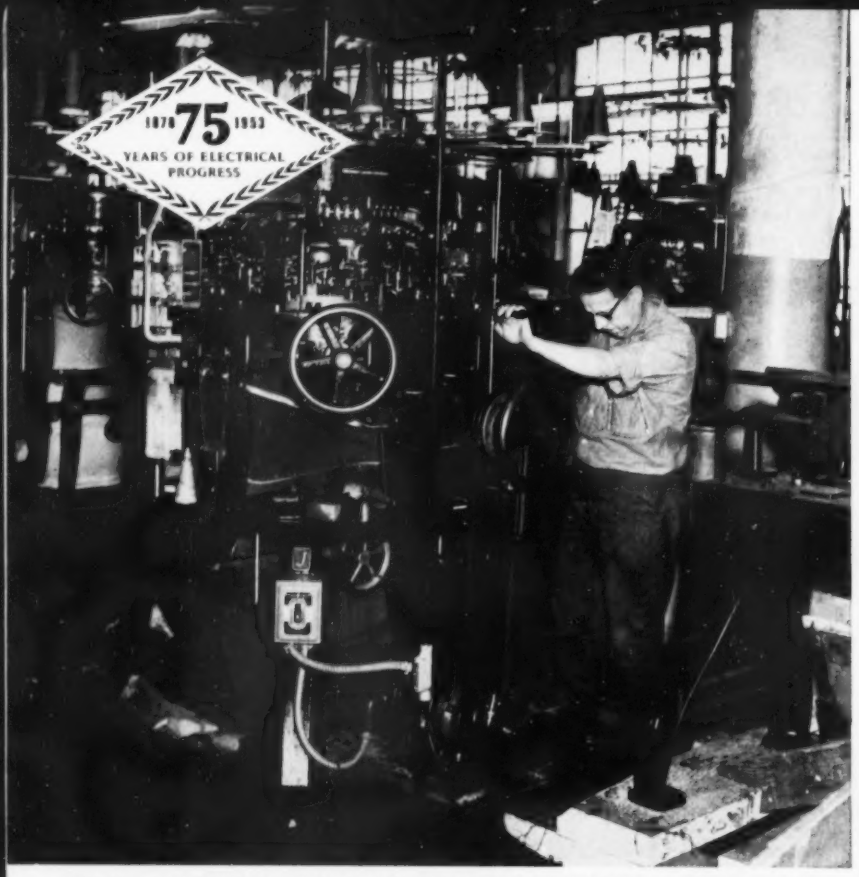
Nepco Header Duct has successful, time-proven features. Produced by the leading manufacturer of electrical roughing-in wiring systems.

EVERYTHING IN WIRING POINTS TO →

National Electric Products

PITTSBURGH, PA.

3 Plants • 7 Warehouses • 34 Sales Offices



LIKE THE BAMBERGER-REINTHAL CORPORATION, CLEVELAND—YOU, TOO, CAN . . .

Modernize Your Equipment With New G-E Gear-motors

The Bamberger-Reinthal Corporation of Cleveland, Ohio recently converted to new G-E Gear-motors for machines knitting sweaters, shirts, stoles, and caps. Bamberger-Reinthal says: "These new G-E Gear-motors are much more efficient than our previous drive. They're the latest thing as far as we're concerned, and they're less expensive to operate and maintain."

G-E Gear-motors will modernize your operation too! Here's why:

G-E GEAR-MOTORS ARE COMPACT, requiring only a little more space than a regular constant-speed motor of the same rating. No external speed reduction equipment is necessary.

G-E GEAR-MOTORS ARE RUGGED. They're engineered to give you years of dependable service under the most severe operating conditions.

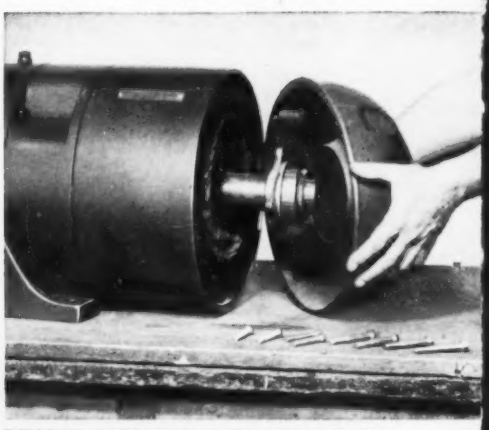
Assure yourself of getting the most efficient, easiest-to-maintain low-speed drive. Specify G-E Gear-motors.

A new stocking plan now makes one-week delivery available on over 300 models. Order your G-E Gear-motor through your nearest G.E. Apparatus Sales Office, or your Authorized G.E. Agent or Distributor. General Electric Co., Schenectady 5, N. Y. 755-11

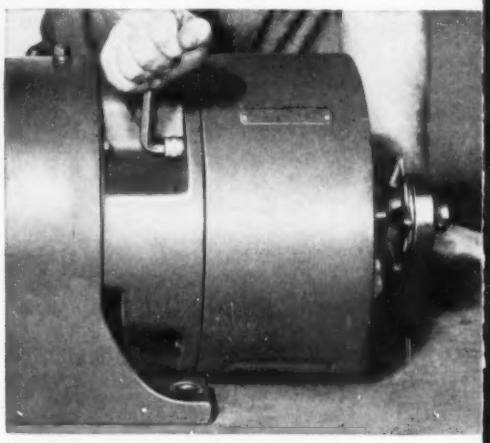
You can put your confidence in—

GENERAL ELECTRIC

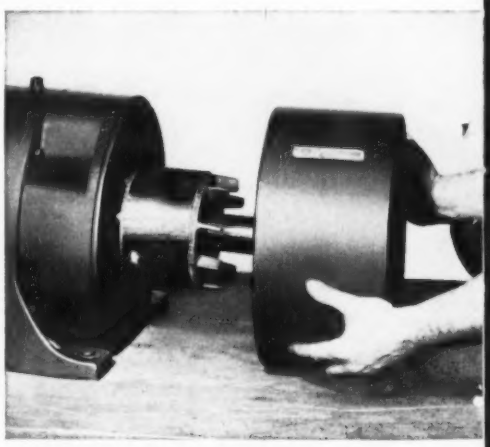
MAINTENANCE IS QUICK AND EASY



REMOVE ENDSHIELD FROM STATOR. If stator removal is required, it's never necessary to remove gear-motor from its foundation or disturb the gear train in any way.



UNBOLT STATOR FRAME BOLTS. Adapter located between motor frame and gear housing gives easy access to stator frame bolts. Note: no special tools are needed.



NOW THE STATOR MAY BE REMOVED. Entire job takes only minutes. This is only one of many features designed to cut "down time" up to 50 per cent.

BULLDOG VACU-BREAK SAFETY SWITCHES

wide open wiring spaces

Extra-large wiring gutters are but one of the many thoroughbred features which make BullDog Vacu-Break Safety Switches easier and cheaper to install and maintain.

BullDog's silvered wire grips—cold-forged from pure copper for maximum strength and conductivity—help make wiring in these roomy gutters a snap . . . save valuable time.

Unequalled protection is yours, too, with BullDog switches because BullDog's exclusive Vacu-Break Arcing Chamber smothers dangerous arcs before they can damage or heat up the contacts. And patented Clampmatic contacts mean bolt-tight contact connections . . . give you a smoother operating, cooler switch.

BullDog's simplified line of Vacu-Break safety switches handles all requirements. Write today for free Bulletin SS-250 containing complete information. BullDog Electric Products Company, Dept. EC 53, Detroit 32, Michigan.

©BEPCO

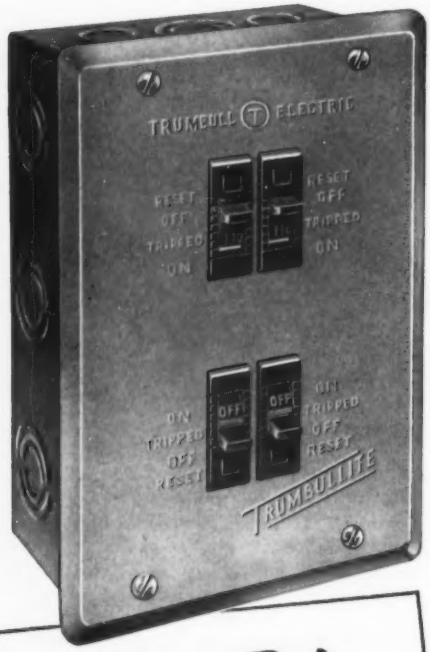
THOROUGHBRED IN ELECTRICAL EQUIPMENT

BULLDOG
ELECTRIC PRODUCTS COMPANY

Three good reasons why you should standardize on

TRUMBULLITE

CIRCUIT BREAKER LOAD CENTERS



1 **Top quality construction:** Bus bars and stabs silver-plated for positive conductivity and corrosion resistance . . . breakers firmly and securely held by pressure contacts. On 12 through 20 circuit sizes bus bars are molded in plastisol . . . resist warping . . . assure long life and dependable protection . . . loads are automatically balanced as breakers are plugged in.

2 **A PLUS feature for any home:** Homeowners will appreciate its trim, modern appearance, its step-saving convenience when installed in kitchen or hall. They will like the split-second restoration of service with no fuses to replace . . . the safe, trip-free, trip-indicating action.

3 **Fast, easy installation:** Plenty of knockouts for easy top, bottom, or rear wiring. Spring-mounted free-floating interior (except 40 amp. main size) for quick alignment. Solid groundable neutral with solderless connectors, circuit numbers clearly marked.

Quick Facts

- Primarily for residential and commercial applications.
- 2 to 20 circuits, 40-100 ampere mains.
- 10, 15, 20, 30, 40 and 50 amp., 120 volt circuits.
- Famous TQL plug-in circuit breakers.
- Two-pole operation of adjacent breakers, through extension handles.
- Disconnecting means and overload protection in one device.
- No external disconnect needed with 6 circuits or less.
- Covers clearly show ON, OFF, TRIPPED and RESET positions.
- Flush, surface or raintight enclosures.
- Underwriters Laboratories listed.

LEADING ELECTRICAL DISTRIBUTORS EVERYWHERE stock and recommend Trumbullite Load Centers. See them for more information, or write us for Bulletin TEB 12A.

TRUMBULL (T) ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY
PLAINVILLE, CONN.

BLACKBURN
Hi-Strength
TWO-BOLT CLAMP

ECONOMICAL! EFFICIENT! COMPACT!

LISTED UNDER REEXAMINATION SERVICE — UL — UNDERWRITERS' LABORATORIES, INC. OF

HERE'S A *UNIVERSAL* CABLE CONNECTOR FOR INSIDE AND OUTDOOR USE

- It costs much less than other types of connectors.
- It's an ideal connector for splices and taps. It's easy to install and is fully approved by Underwriters.
- It's compact and easy to tape.
- It makes a very high pressure joint which results in a tight, low-resistance, *trouble-free* connection.
- It is made of high strength materials throughout — it's truly a quality connector.

Cat. No.	Main	Tap
2B—1/0	1—1/0	6—1/0
2B—2/0	1/0—2/0	6—2/0
2B—4/0	2/0—4/0	6—4/0
2B—350	250—350 MCM	1/0—350 MCM
2B—500	400—500 MCM	2/0—500 MCM
2B—750	600—750 MCM	4/0—750 MCM
2B—1000	800—1000 MCM	4/0—1000 MCM

Jasper Blackburn Corporation

35 MADISON ST. • ST. LOUIS 6, MO.

Phone CEntral 3007

Mail Coupon for Sample and Full Details

Send me sample and further information on the BLACKBURN TWO-BOLT CLAMP.

Wire Size Used _____

Your Name _____

Company _____

City & State _____ EG

Brush it on...peel it off!

BORTHIG # 613 RED

Masking Compound

It Will Save You Time and Money!

Simply **brush** Borthig No. 613 Red Masking Compound on any parts (rough or smooth) that are to be free of varnish, then apply insulating varnish in any manner you wish and bake.

Lift a corner of the compound with the fingers and **peel** it off! No time-consuming scraping of varnish . . . No money-wasting marring of any surface.

It takes only 5 or 10 minutes to dry, and it can stand temperatures up to 325° F.

JUST BRUSH IT ON, PEEL IT OFF AND POCKET THE PROFITS

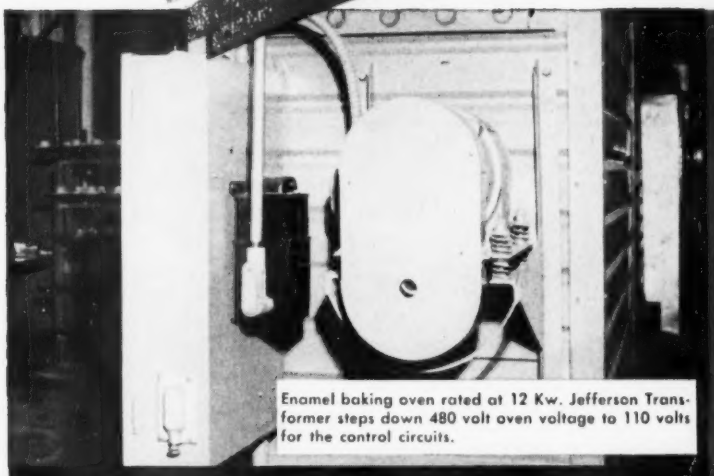
Solved Problems Are Another Product We Deliver.

GEORGE C. BORTHIG CO., INC.

Insulating Varnishes

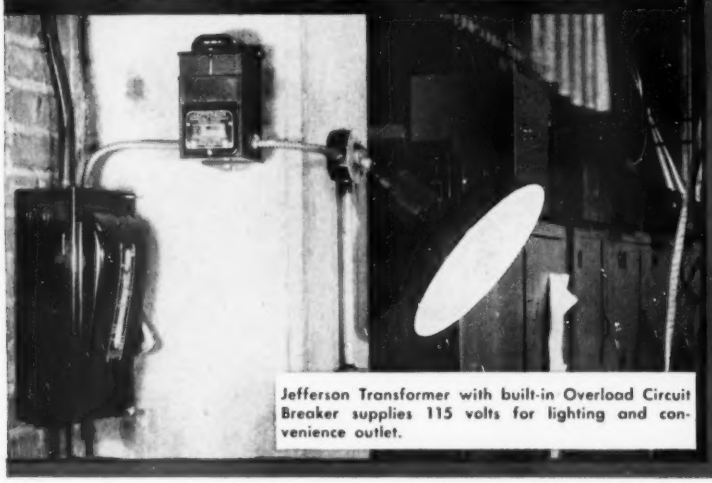
EAST RUTHERFORD, N. J. • P. O. BOX 15

Step Down High Voltage with Dry Type Jefferson Transformers



Enamel baking oven rated at 12 Kw. Jefferson Transformer steps down 480 volt oven voltage to 110 volts for the control circuits.

Jefferson Power Circuit Transformer mounted directly on machine stepping down 460 volts to 115 volts for control circuit and machine lights. Note Overload Circuit Breaker with Reset Button.



Jefferson Transformer with built-in Overload Circuit Breaker supplies 115 volts for lighting and convenience outlet.

Quick conversion of "transplanted" machine to new voltage is possible by installing compact dry-type Jefferson Transformer to allow operation on this plant's 460 volt supply.

SUPPLY LOW VOLTAGE WHERE YOU WANT IT—ECONOMICALLY!

Jefferson Power Circuit Transformers installed at the point where low voltage (115-230V) is required eliminate long secondary feeders, save copper, conduit and maintenance. You improve voltage regulation, eliminate secondary voltage drop. Save money by taking advantage of the economies and efficiencies of modern high voltage power distribution.

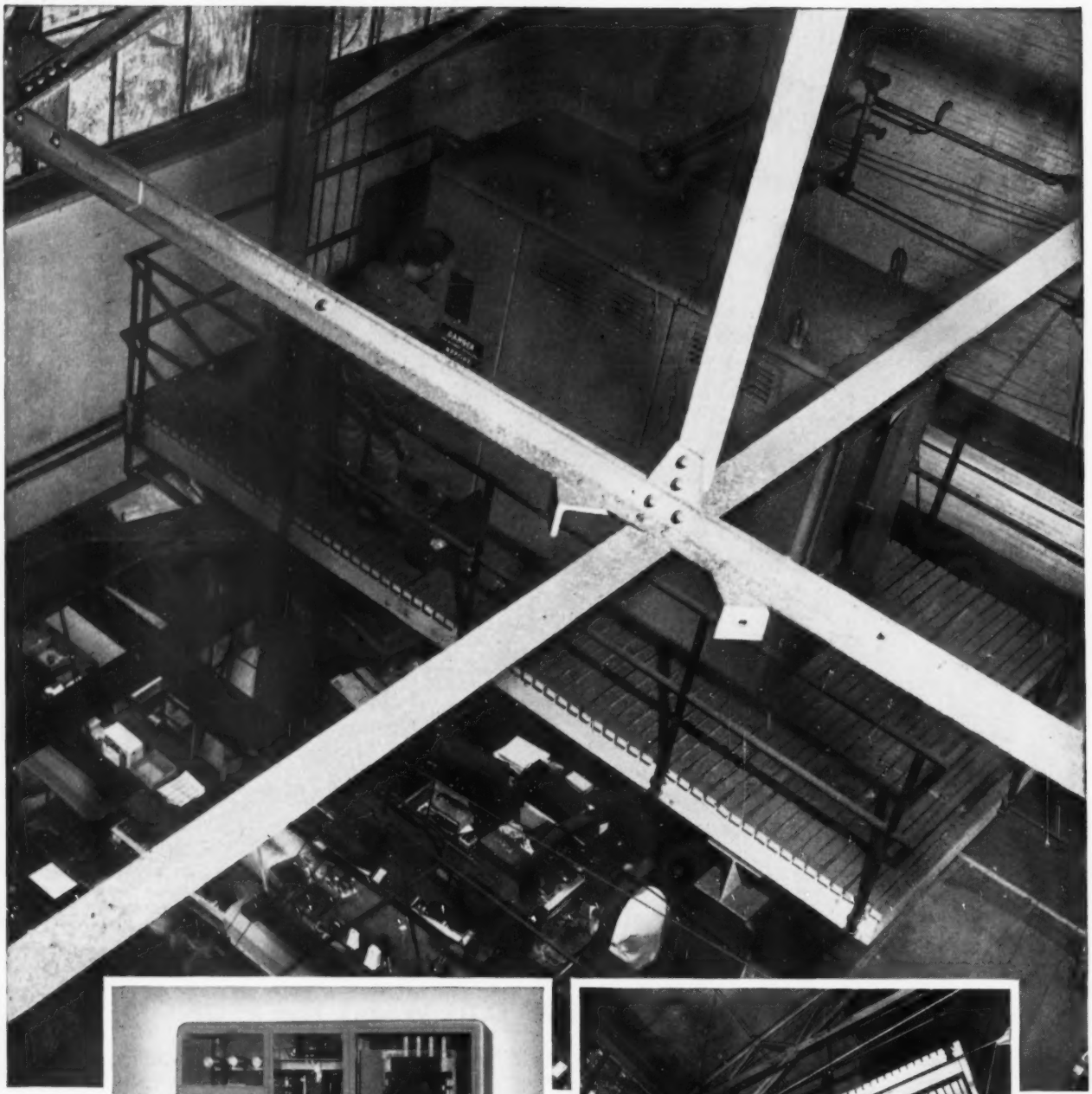
Installing Jefferson Transformers is fast and easy. Sturdy mounting brackets, roomy wiring compartment and ½" and ¾" knockouts are provided. The small compact design permits mounting directly on, or near machinery or other point of low voltage use. Relocating is as easy as moving a switch.

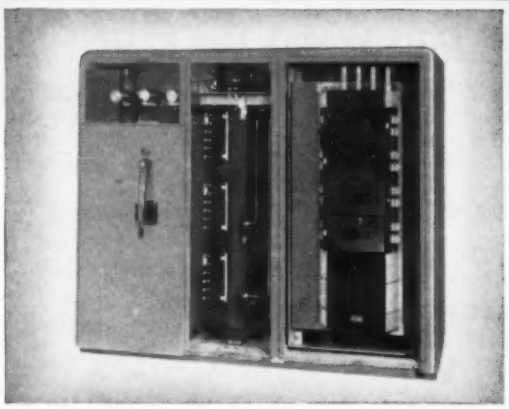
Stock Sizes: 50 V.A. to 15,000 V.A. — 460/230 V. Pri. — 230/115V. Sec. — 575 V. Pri. — 230/115V. Sec. Listed by Underwriters' Laboratories, Inc.

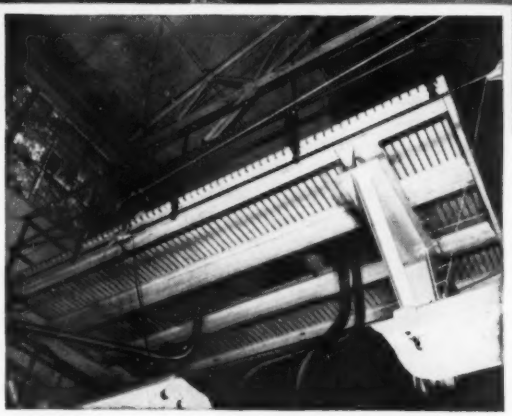
JEFFERSON ELECTRIC COMPANY
Bellwood, Illinois

Jefferson Transformers

SOLD THROUGH LEADING WHOLESALERS







BUILT-IN PROTECTION Separately mounted protective devices are eliminated. Factory-assembled Westinghouse Power Centers offer complete substation protection.

EASY TO INSTALL Floor view of completely enclosed unit. Westinghouse Dry-Type Power Centers are safe . . . to hook up, simply connect high and low-voltage leads.

How Westinghouse Power Centers release space for production

Confronted with the need to modernize his electrical distribution system, an eastern radio and electronics manufacturer installed four Westinghouse Dry-Type Power Centers on overhead platforms, releasing much needed floor space for production.

Change-over from the old system was accomplished section by section, without interrupting production. Each 300-kva integral Power Center, completely assembled, was spotted overhead, close to the center of the load it would serve. Secondary runs were thus shortened, resulting in lower line losses, better regulation, and increased productive capacity of the machinery.

As the old conventional equipment in floor-level vaults was dismantled, additional productive equipment was moved in. The entire change-over was accomplished in 60 days.

Westinghouse Dry-Type Power Centers can bring savings like this to your plant, too. With all protective equipment factory co-ordinated and assembled as a unit, they can be installed quickly and easily. Air cooled, they are safe and eliminate most maintenance headaches. For further information, contact your Westinghouse representative, or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh, Pennsylvania. J-70655

YOU CAN BE SURE...IF IT'S

Westinghouse

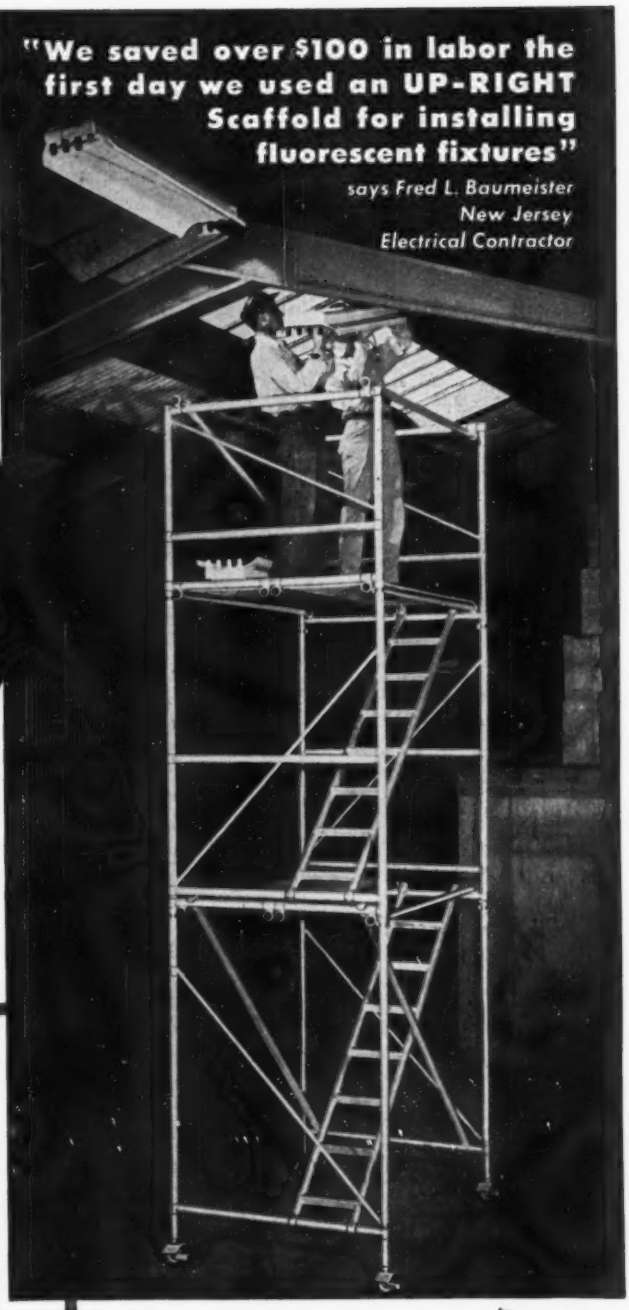
Presto... it's UP!

17 ft. "UP-RIGHT" SCAFFOLD-ON-WHEELS set up in only 3 minutes!

As if by magic, an aluminum alloy tower of any height desired is ready in minutes! Individual scaffold sections are set one on top of the other. Sections lock into place instantly.

"We saved over $100 in labor the first day we used an UP-RIGHT Scaffold for installing fluorescent fixtures"

says Fred L. Baumeister
New Jersey
Electrical Contractor

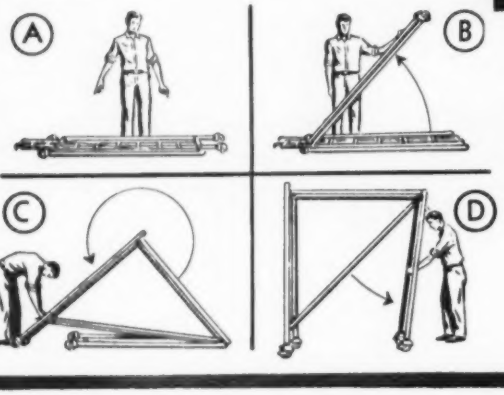


HERE'S THE SECRET!...

PATENTED

ONE-PIECE SECTIONS

Each one-piece section is unfolded by one man in less than a minute! No tools, wing nuts or bolts.



Your maintenance costs can be reduced by "UP-RIGHT" SCAFFOLDS

WRITE FOR DESCRIPTIVE CIRCULAR

"UP-RIGHT" SCAFFOLDS

DEPT. 107 • 1013 PARDEE ST. • BERKELEY, CAL.

Factories: Berkeley, Calif. & Teterboro, N. J.

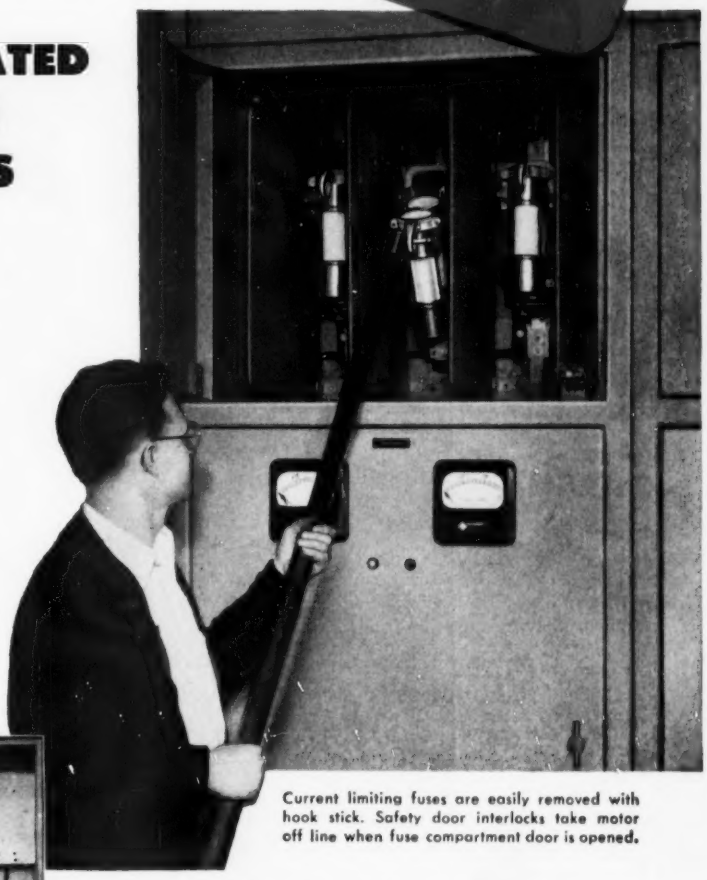
Offices in all principal cities

Personnel Protection

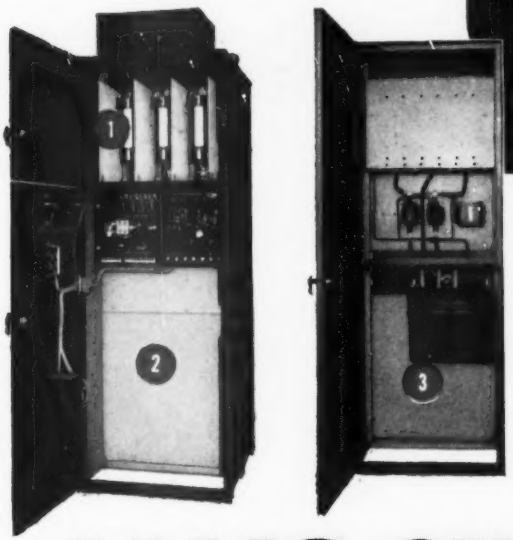
ALLIS-CHALMERS
Type H Starters
FOR 2300 TO 5000 VOLT MOTORS

THROUGH SEGREGATED HIGH VOLTAGE COMPARTMENTS

For positive personnel protection, high voltages are completely segregated in the Allis-Chalmers Type H starter. Full width, heavy sheet steel barriers separate the front low voltage compartment from the rear high voltage equipment and from the upper fuse compartment. It will pay you to get all the details from your nearby A-C representative or by writing Allis-Chalmers, Milwaukee 1, Wisconsin.



Current limiting fuses are easily removed with hook stick. Safety door interlocks take motor off line when fuse compartment door is opened.



3 Compartments Assure Safety

The heavy gauge steel cubicle is divided into three compartments for maximum safety. **1** — Upper front compartment encloses disconnect type fuse. The same operation which puts fuse in position for removal isolates starter from line. **2** — Lower front compartment houses low voltage control devices. **3** — Rear compartment contains high voltage equipment, contactors, buses, instruments, transformers, etc.

A-4002

ALLIS-CHALMERS

As fundamental as hidden pipes...

No electrical contract is really complete unless it contains raceways for telephone wires.

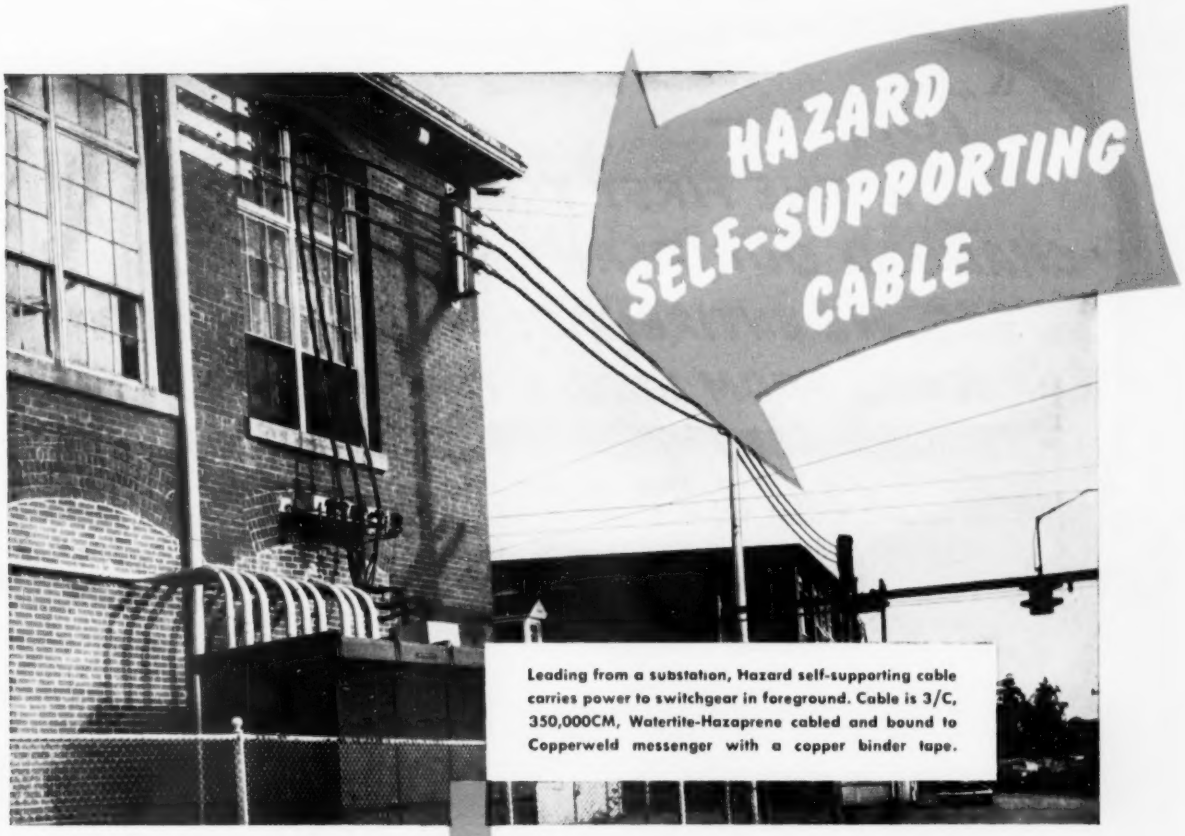
The accepted place for pipes is in the walls where they are out of sight.

And the same goes for *telephone* wires.

Owners are likely to overlook the detail of *concealed* telephone wires. But they are quick to see their value when it's pointed out to them.

It's a simple matter to install a telephone conduit system while putting the rough wiring in a house. And it's a profitable "extra."

BELL TELEPHONE SYSTEM



Leading from a substation, Hazard self-supporting cable carries power to switchgear in foreground. Cable is 3/C, 350,000CM, Watertite-Hazaprene cabled and bound to Copperweld messenger with a copper binder tape.

delivers the goods AT ANCHOR ROME TEXTILE MILLS

In a recent modernization at the Rome, Georgia plant of Anchor Rome Mills, Hazard Watertite-Hazaprene Self-Supporting Aerial Cable was used. Here, you can see the extreme flexibility of the installation . . . it can be strung close to buildings and existing structures with complete safety.

The excellent electrical and physical characteristics of Watertite-Hazaprene were important in the selection of power cable at Anchor Rome Mills. Watertite insulation provides the needed moisture and heat resistance with toughness, resilience and high dielectric strength. The rugged, weather-resistant Hazaprene sheath—the same used for Hazard mining cables—assures long-lived dependability.

Of additional advantage to industrial installations is the "three-in-one" construction of Hazard self-supporting cable. Pre-assembled cable, messenger and binder provides safety, low cost, quick installation and neat appearance. Relocation, when needed, is a simple operation. Get the complete story on dependable, money-saving industrial aerial power circuits from your Hazard representative or write today . . . Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

HAZARD *insulated cords and cables*

1443

"TOM:—
IN THE FIRST YEAR AFTER WE CHANGED OUR PLANT TO FUSETRON FUSES, WE ENTIRELY ELIMINATED MOTOR BURNOUTS FROM SINGLE PHASING AND REDUCED ALL MOTOR BURNOUT BY AT LEAST 75%"
(Excerpt from a conversation of Forrest Baumgardner with Tom Wier)

FORREST BAUMGARDNER, *Chief Electrician*,
Frank Wheatley Pump & Valve Mfr.
Tulsa, Oklahoma.

"FOREST:— DON'T FORGET FUSETRON FUSES DO MORE THAN PROTECT MOTORS — THEY PROVIDE 10 POINT PROTECTION!"

TOM WIER,
BUSS Fuseman,
covering Tulsa, Okla.

1 Protect against short-circuits.*

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

* Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

Here's why FUSETRON Fuses give All Purpose protection...

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses, FUSETRON FUSES fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co.

Don't Risk Losses!

One **lost** motor . . .
One **needless** shutdown . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

Name_____

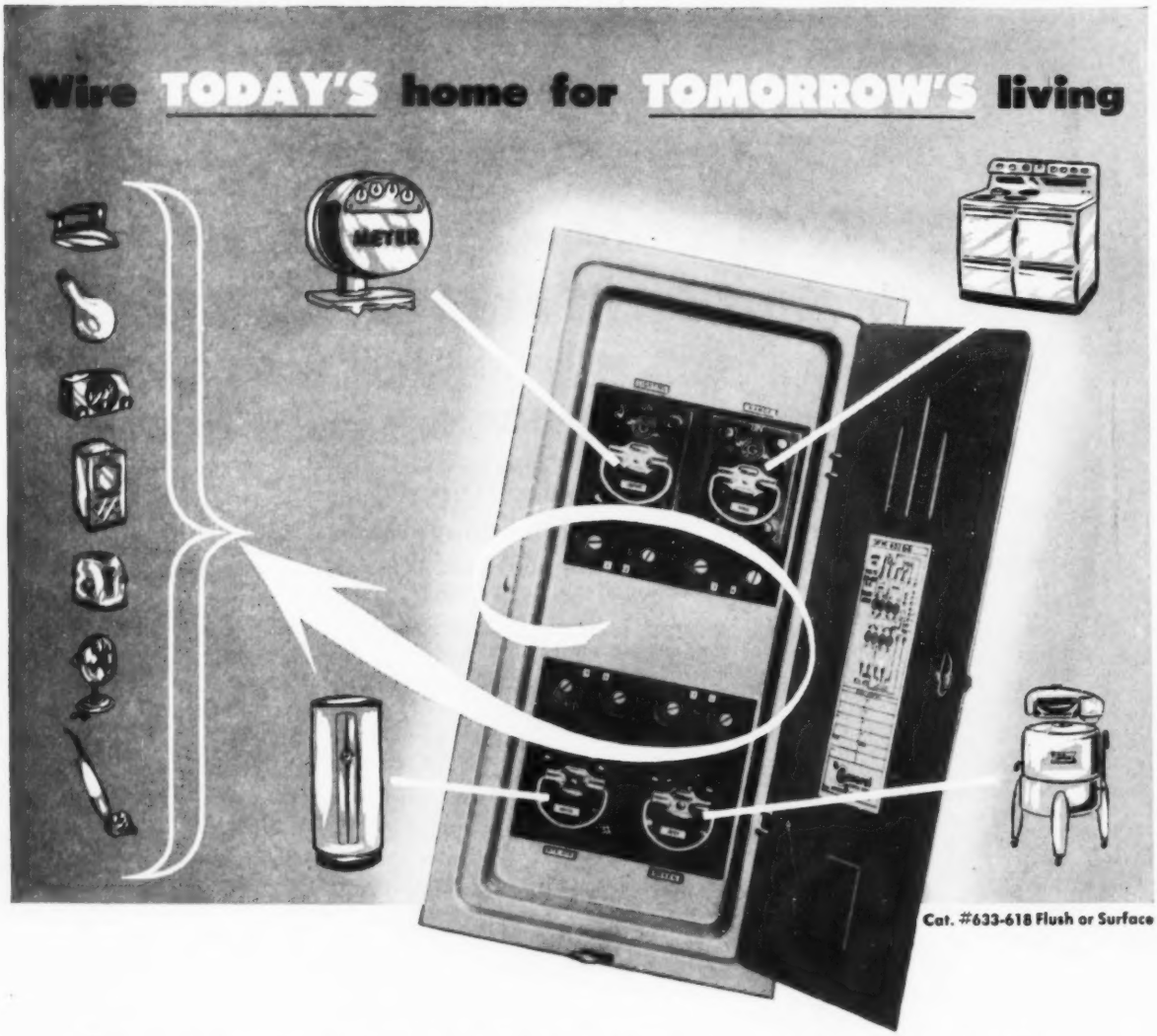
Title_____

Company _____

Address _____

City & Zone_____ State____ ECM-5-53

Wire TODAY'S home for TOMORROW'S living



Cat. #633-618 Flush or Surface

General brings you a "Main and Range Plus"! The *quadruple* pullout unit that actually plans for the future. Not only does this all-in-one unit take care of today's wiring requirements . . . it *anticipates* tomorrow's needs. Eliminates costly auxiliary wiring equipment, and unsightly additions. The General Quadruple Pullout unit is neat, compact, thoroughly dependable. It saves you time and materials . . . at a price you want to pay. No wonder wholesalers and contractors all over the country are saying: Switch to General today! Available everywhere exclusively through wholesalers.

100 Amp. main lugs feed 4 pullouts connected in parallel. One 60 Amp. functions as a main disconnect for eight 30 Amp. plug-fuse branch circuits and the 60 Amp. sub-feed lugs. Three additional pullouts (one 60 Amp. and two 30 Amp.) control appliances such as, Ranges, Water Heaters, Dryers, etc. Other combinations may be ordered.

Sales Offices in every Major City

General Switch Corp.

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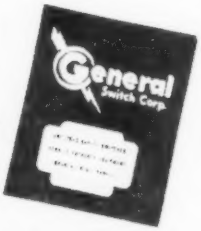
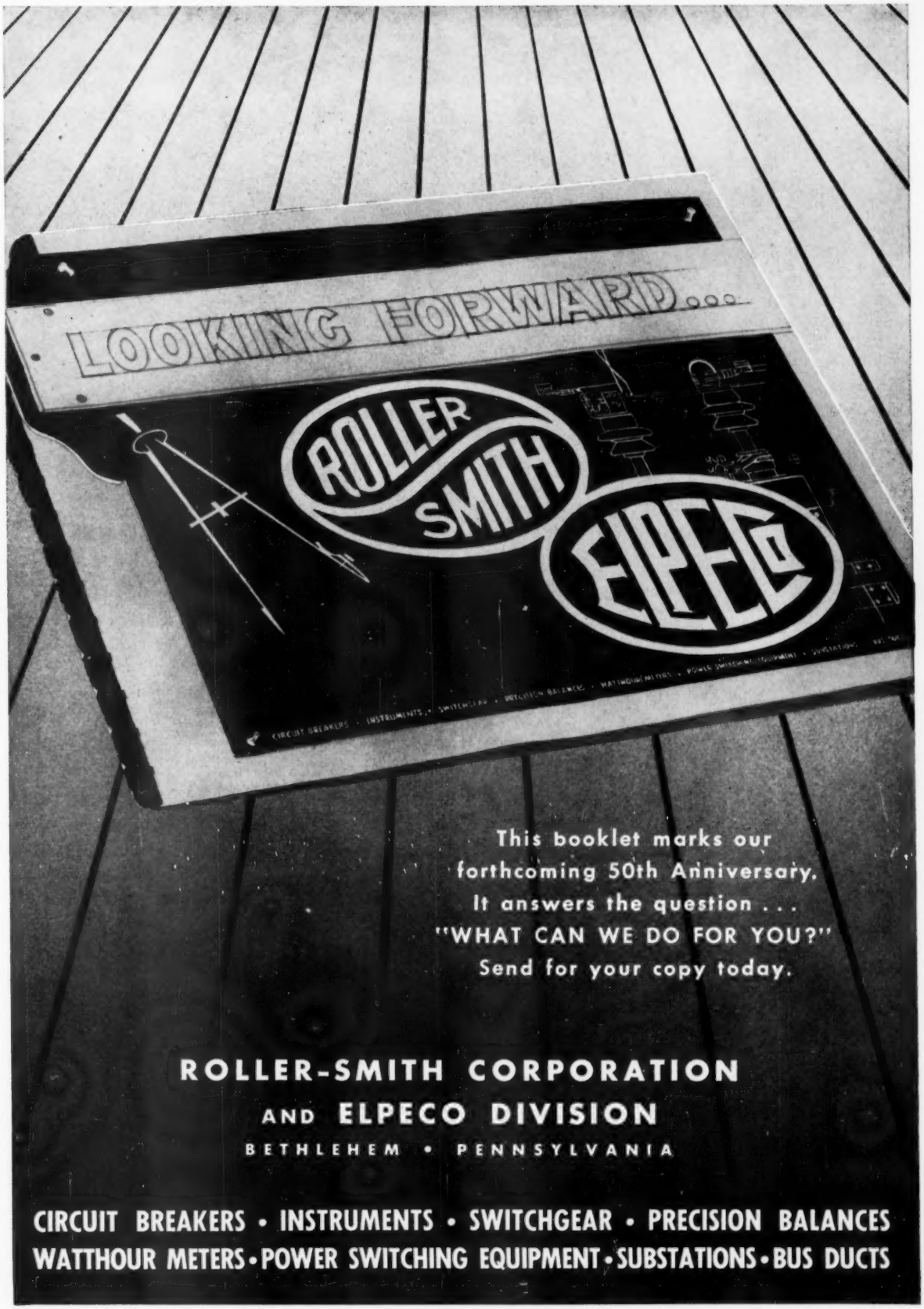


ENCLOSED SAFETY SWITCHES • SERVICE ENTRANCE EQUIPMENT • BRANCH CIRCUIT PANELS



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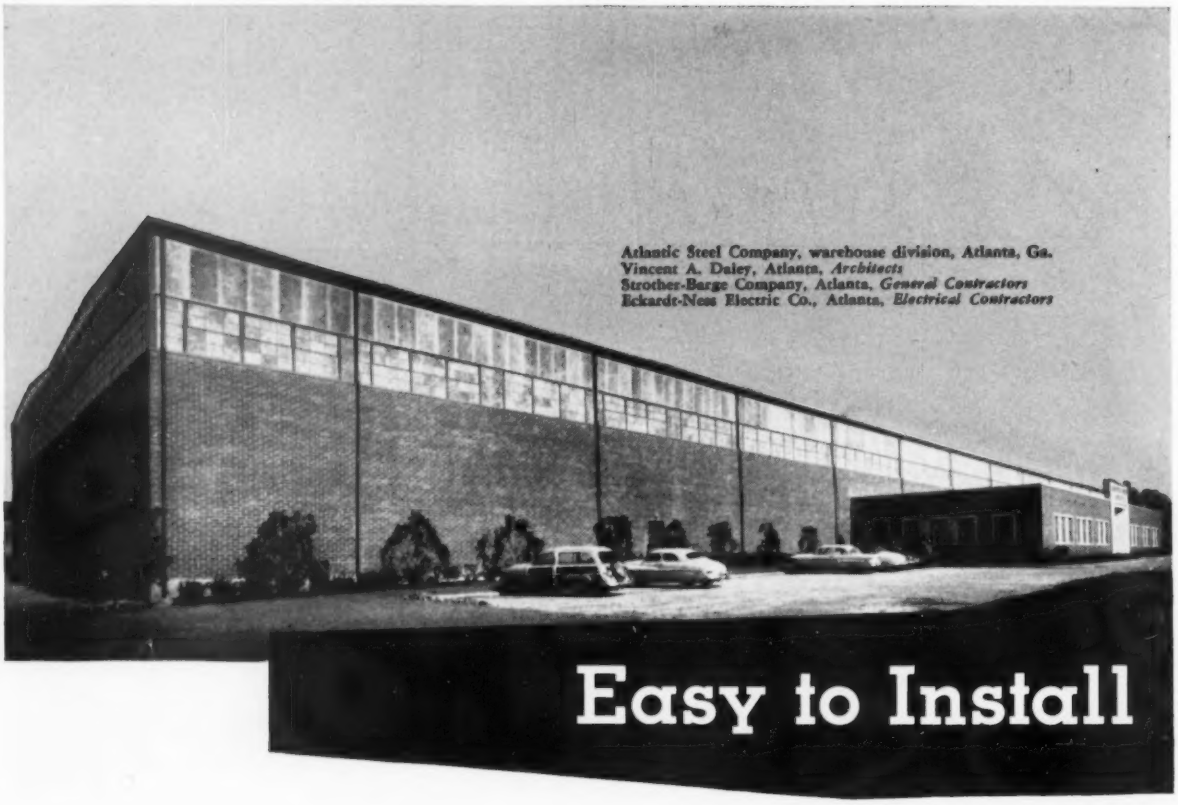

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It's easy to assemble the pre-bent lengths of Republic ELECTRUNITE E.M.T. high in the girders and purlins of this steel warehouse. Without turning whole runs of raceway, moisture-tight connections require only wrenches or heavy duty pliers.

Republic ELECTRUNITE E.M.T. is exclusively "Inch-Marked" for easy, accurate cutting and bending without measuring the tube. It is uniformly ductile, will bend smoothly. Exclusive *inside-knurling* provides a surface for easier wire-pulling.

For concrete-slab, concealed, and exposed installations, order the brand that's first in preference with electricians everywhere... Republic ELECTRUNITE... the *"Inch-Marked"* E.M.T.

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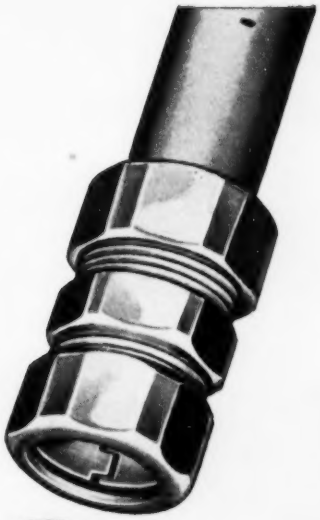
Installation of Republic ELECTRUNITE E.M.T *in and around steel purlins, girders and columns is easier . . . connections are tightened without awkward turning of whole runs.*



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"Inch-Marked®" lengths speed accurate bending with Republic ELECTRUNITE *E.M.T. . . . uniform ductility assures smooth, unrestricted bends.*

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for maximum Service . . .

INSTALL FA

FA SHUTLBRAK
30 to 1200 amps, 250 volts AC or DC and 600 volts AC.

FA CIRCUIT BREAKER
15 to 600 amps, 250 volts AC or DC and 600 volts AC. For larger capacities, Air Circuit Breakers are used.

FA KLAMPSWITCHFUZ
30 to 600 amps, 250 volts AC or DC. SNUFARC, 30 to 200 amps, 600 volts.

STANDARDIZED SWITCHBOARDS

STANDARDIZED FA SWITCHBOARDS are noted for their efficiency, safety, and dependability.

Built of standardized pre-assembled units, incorporated in standardized enclosures, these sturdy, long-lasting and trouble-free power centers embody the latest features of design and operation.

Standardized FA Switchboards are of three types — the **Shutlbrak,** a safety type switchboard designed for frequent operating use; the **Klampswitchfuz and Snufarc,** which features a dependable hinged type, pull-out switch unit for disconnect service on lighting and power circuits, and the **Circuit Breaker,** another safety type, featuring the latest developments in automatic circuit protection.

All Standardized FA Switchboards are factory assembled and shipped ready for connection to main and branch circuit cables. Units can be arranged singly or grouped because all sections fit readily together. Removable end walls permit the addition of sections on either side.

Want to know more about these efficient, long-lasting power centers? Your nearest FA representative listed in Sweet's will be glad to give you complete information.

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DEPRECIATION

And Its Crucial Economic Role

The sixth annual McGraw-Hill survey of Business' Plans for New Plants and Equipment, just completed, reveals some remarkable facts about the role of depreciation in our economy. To most people, depreciation is a technical term, used by accountants to discuss a dull subject. But it really is a simple matter: It is the amount of money set aside each year by a company to replace plant and equipment that is wearing out. And here are some facts from this survey* which show how depreciation can make the difference between prosperity and recession in the United States:

1. *In 1953, about half of all the money spent on new manufacturing plants and equipment will come from depreciation reserves.* For the future, manufacturing companies are relying even more heavily on this source of money. In the years 1954-56, they count on using their depreciation funds to pay for almost two-thirds of the new plants and equipment now planned.

2. *The amounts of money made available by depreciation allowances vary greatly from industry to industry.* Some industries, such as those producing steel, chemicals and petroleum products, will have relatively large amounts of cash available from their depreciation reserves. In considerable measure, this is because the government is allowing them to accumulate such reserves at an accelerated rate as an encouragement to build facilities required for national defense. But most of the companies engaged in the production of textiles, processed foods and many kinds of machinery have had little chance to benefit by this provision for accelerated depreciation. Hence, they have much less money available from depreciation reserves.

3. *There is a definite shortage of investment funds in the industries that have relatively low depreciation allowances.* Taken together, the coal mining, textile, food processing, machinery and other metal-fabricating industries plan to spend about $4.7 billion for new plant and equipment this year. But they report that they would spend $1.5 billion *more* per year during the period 1954-56 if sufficient funds were available.

4. *Eighty-five per cent of the manufacturing companies covered by the survey reported that they plan to invest all their depreciation funds* to keep equipment up-to-date and to provide capacity for new products and new markets. These companies could let their depreciation funds pile up as idle cash. But the intention is to spend most of them for capital equipment.

*The sixth annual McGraw-Hill survey of Business' Plans for New Plants and Equipment included companies that provide 25 per cent of all industrial employment and 60 per cent of employment in those industries where capital investment is highest. These companies are mostly the larger companies in their respective industries. A copy of the full report of this survey can be obtained by addressing: Department of Economics, McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York 36, N. Y.

Hence, there is a direct relationship between the amount of depreciation funds available and the level of capital investment. And it is upon the latter that the level of general prosperity decisively depends. One-third of all industrial workers are engaged in producing or installing such equipment.

This fact that the level of depreciation allowances has a major bearing on the level of capital investment should not surprise anyone. In several foreign countries where these allowances have been increased, investment has boomed. The two nations with the highest ratios of investment to national income are Canada and Norway. Both countries adopted flexible depreciation policies after World War II. In Sweden and The Netherlands also, flexible depreciation allowances have contributed to rapid industrial expansion. Finally, the tremendous investment brought about by our own rapid amortization program shows dramatically the importance of depreciation in stimulating capital expenditures.

Obsolete Tax Laws

In spite of this record, the fact remains that our laws and the business procedures that govern depreciation allowances — in particular the laws and rulings that govern the deduction of depreciation from taxable corporate income — are still based on antique and obsolete accounting concepts which take no account of depreciation's dynamic role in our economy. The internal revenue code still requires most companies to depreciate their equipment over a long period, even though these small annual allowances cannot possibly pay for the investment that is necessary to keep a plant up-to-date under today's rapidly changing technology, with its production of new and improved machinery.

The only allowance made by the government for rapid depreciation is that which is authorized for certain types of plants during the defense emergency. Under this policy most companies are unable to use accelerated depreciation for tax purposes. And as defense projects are completed, the number of new authorizations is dropping. We may lose the chance to utilize fully this powerful tool for sustaining investment because, under our ramshackle emergency tax structure, accelerated depreciation is available only to a minority of firms on a temporary basis.

New Policy Needed

A sensible, up-to-date depreciation policy for tax purposes is long overdue. Either the Treasury must modernize the internal revenue code on its own initiative, or Congress must take the lead by writing into permanent law a flexible depreciation policy applicable to all companies.

Treasury experts now have before them a number of proposals to allow faster depreciation for the average firm. The U.S. Chamber of Commerce has suggested that companies be allowed to deduct from taxable income 25 per cent of the cost of new equipment in the first year, with the remaining cost to be deductible over the life of the facilities. The Machinery and Allied Products Institute has long sponsored a formula that would allow full deduction in two-thirds of the estimated life of the property. In Congress, Chairman Reed of the Joint Committee on Internal Revenue Taxation has stated that we need a more flexible depreciation policy. Senator Frear of Delaware has introduced a bill that would let a business make its own choice on how fast to depreciate its equipment.

It will take time and study to determine which of these various proposals best fits the needs of the economy without sacrificing unduly the revenue needs of the government. If we are to have a new depreciation policy, designed for a long period ahead, it must be carefully worked out. But this much is clear right now: *The development of a flexible depreciation policy on the part of the federal tax authorities is one of the most important steps that can be taken to sustain prosperity. When we talk about depreciation, we are talking about the money that pays for almost two-thirds of the new manufacturing facilities now scheduled for construction. We are talking about the new investment and the new jobs on which our continued prosperity depends.*

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Corrosion won't hurt this TRI CLAD motor's cast-iron frame

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HERE'S A COMMON SIGHT AROUND MANY PLANTS— A G-E Tri-Clad motor operating reliably and continuously under the extremely corrosive conditions that cause many other motors to fail.

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TESTING TIPS for the maintenance of plant equipment

G-E Wattmeter Speeds Testing Without Slowing Down Production

Just hook a G-E AK-2 wattmeter around the conductor, clip the leads across the line, read power. This simple, quick operation can cut hours from your maintenance schedules without damaging conductors at all.

Costly production shutdowns while gathering power facts are not necessary—if you own an AK-2. Use on insulated as well as non-insulated conductors.

GENUINE VERSATILITY

Its wide variety of uses will make the AK-2 one of your most valuable instruments. You can use it for trouble-shooting, motor-load tests, plant-load surveys, and many other applications.

With the G-E AK-2 hook-on wattmeter, you can get power readings from either single-phase or polyphase circuits. Vars in balanced three-phase circuits can also be measured.

BUILT FOR ACCURACY

A dovetail joint on the magnetic jaws results in a clean, interlocking fit. This means that errors from imperfect closings are cut to a minimum.

Accuracy is further assured by the AK-2's thorough magnetic shielding, which reduces the influence of adjoining conductors to negligible quantities.

WIDE RANGE

The G-E AK-2 hook-on wattmeter will measure from 3 to 300 kw on ranges of 15–600 amperes, and 100–600 volts. Price is $95.53.* For additional details, write for bulletin GEC-951.

*Manufacturer's suggested retail price.

Get Dependable Temperature Measurements with a G-E Dual-range Hand Pyrometer

Here is an instrument as rugged as any shop tool—the FH-1 hand pyrometer. Yet, you can depend on its accuracy in reading after reading—whether you're measuring the temperature of surfaces, liquids, gas or molten metals.

Automatic cold-junction compensation prevents any distortion of the reading from changes in the ambient temperature surrounding the instrument. This feature even compensates for the temperature of the instrument itself.

DUAL RANGE SAVES MONEY

This single unit offers two ranges—0–500 F and 0–1500 F. Besides eliminating the need for buying several single-range pyrometers, the FH-1 cuts hours off testing time. The operator carries only one instrument. Furthermore, he can switch from one range to the other with a simple flick of the thumb.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, and a two-prong contact are available for the FH-1. Also available are a carrying case, and both flexible and rigid extension arms. Both tips and arms can be changed in a matter of seconds without recalibration or further adjustment.

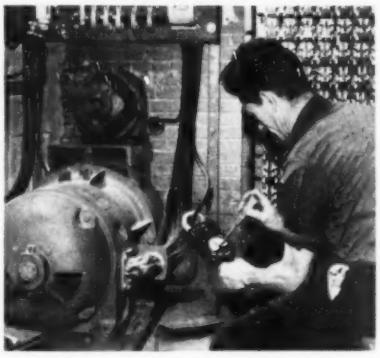
MORE INFORMATION AVAILABLE

The G-E FH-1 hand pyrometer can help you to eliminate waste resulting from wrong temperature guesses. Write for bulletin GEC-836. Price, including all three tips, both extension arms, and the carrying case, is $191.20.*

Hook-on Volt-ammeter Offers 8 Ranges; Will Measure Motor-starting Currents

Eight easily read scales make the G-E AK-1A hook-on volt-ammeter suitable for a wide range of applications. This versatile instrument offers five current scales—one from 0 to 7.5 amps, to read those low-amp circuits, and four others all the way up to 750 amps. Three voltage scales are provided—from 0 to 150, 300, and 750 volts.

The AK-1A offers value beyond that of an ordinary volt-ammeter by indicating motor-starting currents. A simple screw adjustment of the pointer-stop mechanism gives you this reading.



STURDY, SAFE CONSTRUCTION

A strong Textolite† case enables the AK-1A to stand up against unusual service abuses without cracking or chipping.

Complete insulation, together with the one-hand, hook-on operation means maximum safety to the user. Low price is $66.74.* Send for bulletin GEC-901.

†Reg. trade-mark of General Electric Company

When ordering bulletin, write to Section 602-262, General Electric Company, Schenectady, N. Y.

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This complete AB-I Circuit Breaker line

solves more of your customers' problems—means more sales protection for you

Here's how to line up bigger circuit breaker sales—with the complete line of Westinghouse AB-I Circuit Breakers.

As shown above, there's an AB-I Breaker for *every* operating condition—indoors and outdoors, in wet and dusty locations, in explosive or corrosive vapors and dusts. Solving any application problem is merely a matter of selecting the right NEMA enclosure. Ends shopping around for "specials"—enables you to bid on jobs you couldn't handle formerly.

AB-I's solve many customer problems. They reduce downtime as much as 98%* compared with fused devices—eliminate dangerous fuse bridging, too. They save on maintenance—no replacement parts needed. They end unnecessary power outages with inverse-time-delay tripping action. And they protect workmen from live parts and costly accidents.

Certainly, AB-I Circuit Breakers can do a lot for your customers—and you! For complete information call your Westinghouse Representative or write for B-5456, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

*Name of company on request

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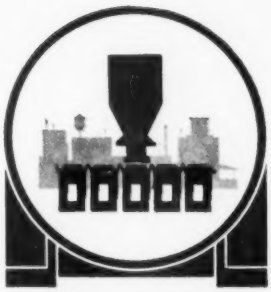
YOU CAN BE SURE... IF IT'S Westinghouse

Metal Working



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Grain Handling

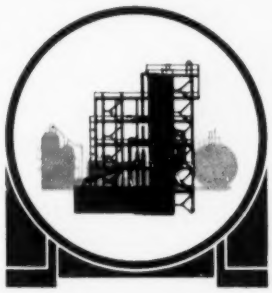
Electric Motors

for every industry

When you need electric motors . . . in any rating, or frame type . . . one or a thousand . . . *always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry.

Fairbanks, Morse & Co., Chicago 5, Illinois.

Chemical Processing



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Fairbanks-Morse totally-enclosed, fan cooled motor—in a complete horsepower range.

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announcing the most Revolutionary fixture design in the last decade

Patent Applied for

Now, for the first time, FIVE outstanding construction features, each a new concept of fixture engineering, that will save at least one fourth of installation and maintenance costs. These important innovations, *found only in the Gibson HOLO-77,* are available at no increase in cost over conventional quality fixtures.

UNI-RACE*, a sectional beaded channel that provides automatically exact fixture spacing with calculated clearance between units — positive alignment — a continuous open wireway.

TERMINAL BLOCK CONNECTOR can be wired-in using only a screw driver in as little or 32 seconds. No lead, rubber tape or wire nuts required with 90% saving of wiring in time.

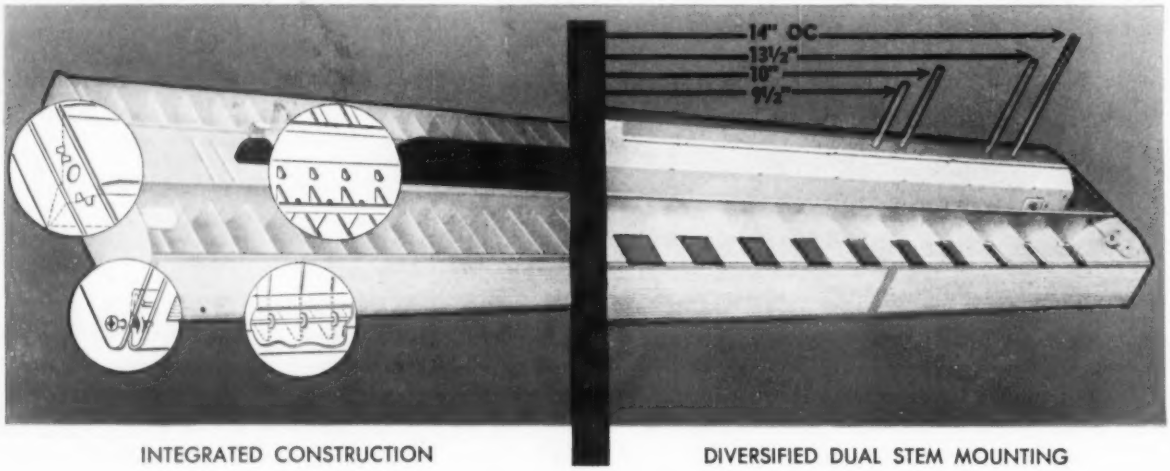
INTEGRATED CONSTRUCTION with each part locked to each adjoining part forming an inseparable unit of greatest possible strength and rigidity.

"V" TYPE GIRDER, 4⅜" deep, capable of supporting more than 40 pounds at center without perceptible deflection in eight feet, provides the heart of this rugged unit.

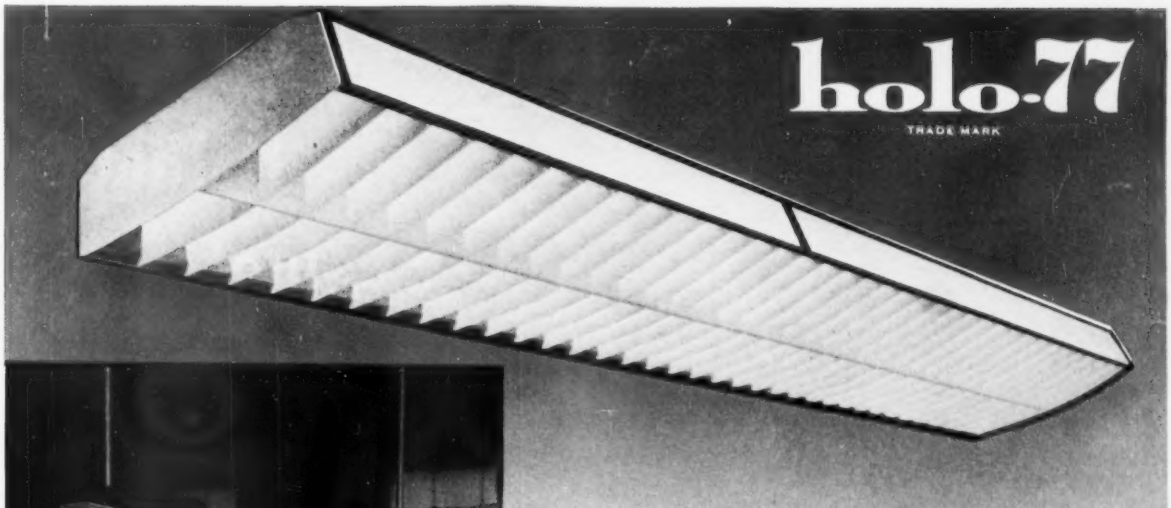
DIVERSIFIED DUAL STEM MOUNTING providing adaptability to practically all dual stem sets without modification through positioning of multiple knockouts in the Uni-Race.

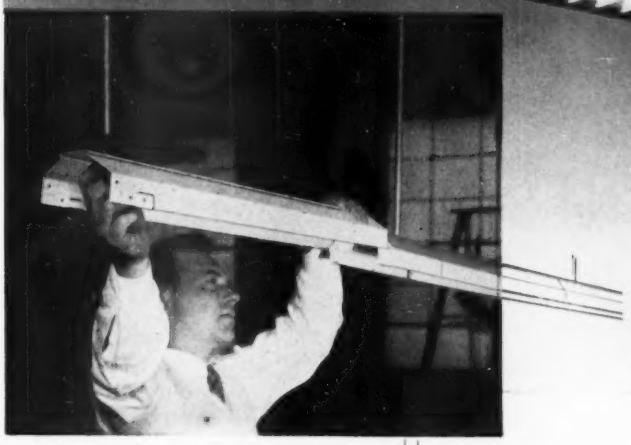
*Trade Mark

Standard fixture wired in rapid start or slimline • 40 watt, 62 watt, 75 watt • two and four lamp shielding angle 35° lateral 45° longitudinal or 35°-30° • side panels of plastic, metal and plastic or glass



INTEGRATED CONSTRUCTION DIVERSIFIED DUAL STEM MOUNTING





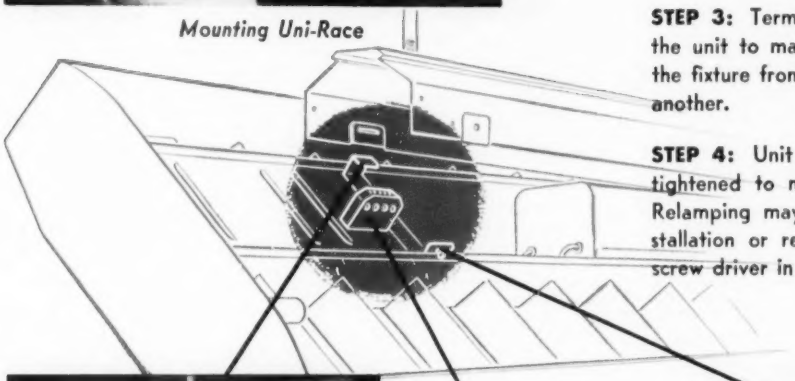
Mounting Uni-Race

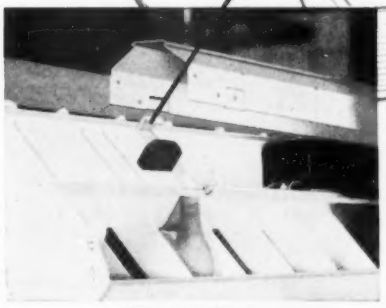
STEP 1: Mount the Uni-Race, a rigid, readily accessible open wireway which can be infinite in length. It is adaptable to any type of mounting and is punched for automatic spacing in continuous runs to a tolerance of less than .040.

STEP 2: Hook the fixture in slots on the Uni-Race with as much ease as hanging an ordinary louver assembly. Slots on Uni-Race assure perfect alignment and spacing.

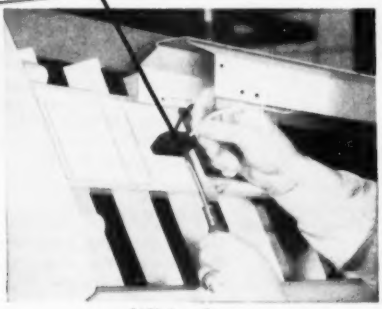
STEP 3: Terminal block connectors are provided on the unit to make a positive, solderless connection to the fixture from the Uni-Race and from one fixture to another.

STEP 4: Unit is snapped closed and take-up screw tightened to make a rigid, vibrationless connection. Relamping may be accomplished in position and installation or replacement can be made with only a screw driver in less than 60 seconds.

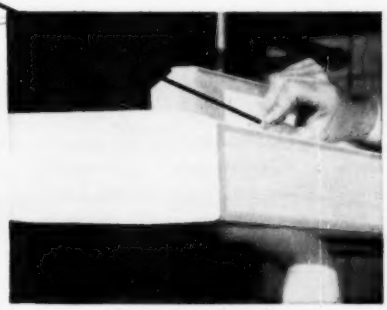




Hanging Fixture



Wiring-in



Snapping closed

GIBSON *Manufacturing Co.* **1919 Piedmont Circle, N.E., Atlanta, Georgia**

It takes just a handful

OF T&B ENGINEERED LOCK-TITE CONNECTORS

to tap . . . terminate . . . or splice on all your jobs

Easy installation using only a standard key wrench. 1

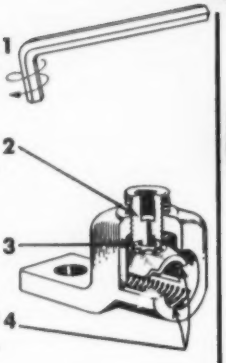
Fitting operates on screw-and-saddle principle. 2

Built-in lock washer keeps fitting tight. 3

Serrated saddle and body for better grip. 4

Force applied here is greatly multiplied by leverage screw . . . gives tight all-around grip on cable. 5

T & B designed saddle securely holds large cables or small cables of all types. 6



T & B Lock-Tite fittings are engineered for long service . . . they cost you less to install—be sure to use them on your next job.

LOCK-TITE LUG

One-piece design holds all kinds of conductors: solid, stranded flexible, extra flexible, hemp core, rod, and tubing. Uniform all-around pressure means high conductivity. Only 7 sizes handle all cables from #4 solid to 1000 MCM.

LOCK-TITE TEE-PARALLEL TAP

A versatile, one-piece fitting for use as a tee, parallel, elbow, crossover, two-way, or reducing connector. Hinged top hooks over the "main"...lower opening holds the "branch". Only 13 sizes connect all combinations of "main" cable (1/0 to 1000 MCM) to "branch" cables (#2 to 1000 MCM).

LOCK-TITE TWO-WAY CONNECTORS

Neat and smoothly-rounded fittings for end-to-end connections. Cables are held by individual overlapping, serrated saddles. Each connector takes several cable sizes—you can use it as a reducer. The completed joint is small, streamlined, easy to tape. Only seven sizes handle all cables from #4 solid to 1000 MCM.

TWO other handy, T & B pressure connectors

HINJON JUNIOR TEE-PARALLEL TAPS

Compact, one-piece connector taps small branches to large mains. Self-adjusting jaws grip main and branch cables all around. To make a tee tap, just bend the branch wire at right angles. Installed easily with only a screw driver. Twelve sizes connect all combinations of "main" cables (#8 to 1000 MCM) to "branch" wires (#14 to #1).

LUGITS—Quickly installed terminals for small cables. Double thickness at the thread locks the screw in place. Copper tongue is serrated for positive grip on cable (sizes #14 to 4/0). Screwdriver tightened.

LOOK FOR THIS SIGN—

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T319

THE THOMAS & BETTS CO.

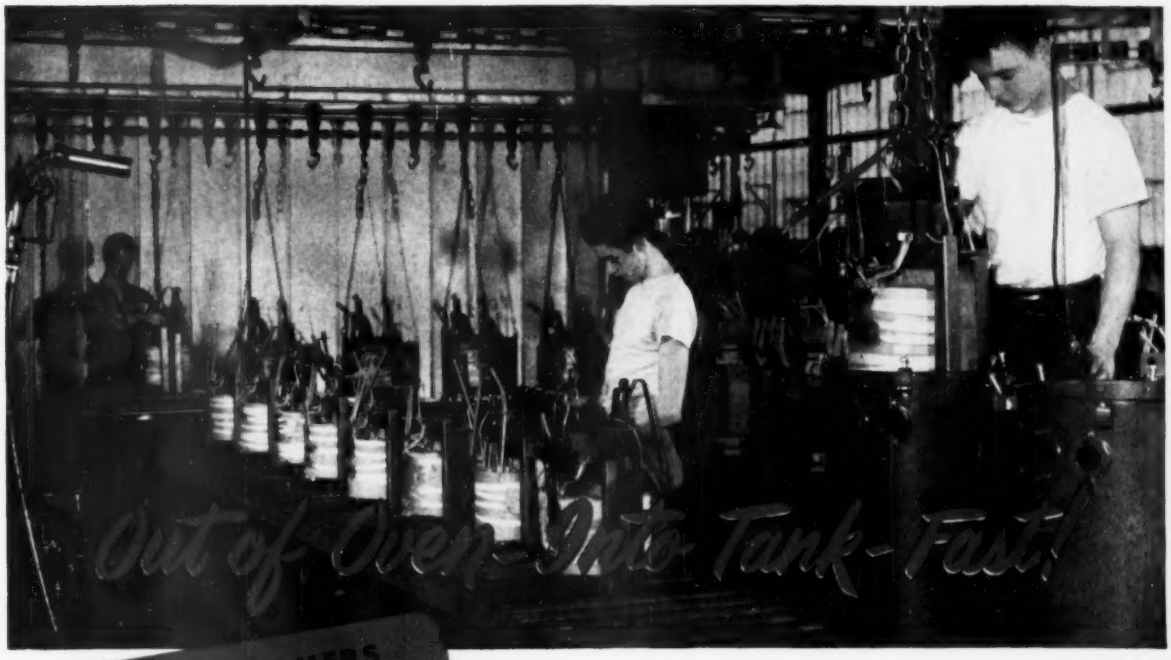
INCORPORATED

34 Butler Street • Elizabeth 1, New Jersey

Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

How Moisture is Kept Out of Transformer Coils



Fast sequence from drying oven into tank is one reason why you get consistently excellent insulation quality in Allis-Chalmers distribution transformers.

Here's How It's Done

Core and coil assemblies move continuously through the tunnel-type electrically heated oven partly shown in the background above. Then . . . immediately after the drying cycle is complete . . . they are immersed in dry oil in their own tanks. This prevents any absorption of moisture that might have occurred if the cooling had been done in air. Then a vacuum drawn on the transformer removes any air entrapped in the oil.

Finally, Production Line Impulse Testing

As a final step, production line impulse testing is used to assure uniform high insulation strength.

Get All Benefits

Careful attention to manufacturing detail is only one of the many reasons why you benefit when Allis-Chalmers distribution transformers are on your system. For complete information, call your nearby A-C district office or write Allis-Chalmers, Milwaukee 1, Wis.

A-3977

ALLIS-CHALMERS

Compare the

Continuous current rating is permanently engraved on every I-T-E Circuit Breaker. Here's straightforward assurance that the *complete* device (both protective and disconnect features) has been tested as a *unit* under load and approved for the rating specified.

I-T-E INDIVIDUALLY-ENCLOSED

current ratings before selecting electrical protective devices

I-T-E CIRCUIT BREAKERS WILL SAFELY CARRY THEIR *FULL* CONTINUOUS CURRENT RATING INDEFINITELY

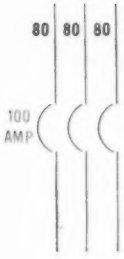
First, bear in mind that every I-T-E Circuit Breaker is tested and rated as a complete *unit*. The rating prominently engraved on the breaker is the true current rating of a protective device, as well as a disconnect device.

Then consider that an enclosed fusible switch is tested and rated as a *switch alone*. If tested as a unit complete with conventional fuses, it would not safely carry its full-rated current continuously. The heat generated before the fuse would blow could be terrific; the switch portion might not stand it.

That's why The National Electrical Manufacturers Association recommend that "fused switches should be selected so as to have a rating at least *50 percent in excess of the load*, for *continuous duty*."

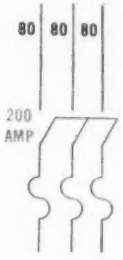
Circuit breakers, however, are taken at "face value."

For example —Suppose you have the problem of providing circuit protection for a feeder supplying a continuous-load lighting panelboard. It happens you have 80 amperes traveling over each wire of a 3-phase feeder system. Selected wire size is rated 100 amperes. (The National Electrical Code says wires cannot be loaded continuously to greater than 80% for safety.)



CIRCUIT BREAKERS

for this job are selected simply. *Just match the circuit breaker rating to the wire size!* Install an enclosed *100-ampere* 3-pole I-T-E circuit breaker for complete protection and safety.



ENCLOSED FUSIBLE SWITCHES

for this job (according to NEMA) should be rated at least 50% in excess of the 80-ampere load. This means a 120 ampere current rating. In this case, it would be necessary to apply the next higher standard size—a *200-ampere* switch!

I-T-E CIRCUIT BREAKER CO. • 19th AND HAMILTON STREETS • PHILADELPHIA 30, PA.

The I-T-E distributor nearest you carries a complete stock of I-T-E individually enclosed circuit breakers.

CIRCUIT BREAKERS

HE'LL GROW FROM THIS

TO THIS

BEFORE YOUR WESTINGHOUSE FLUORESCENT LAMP BURNS OUT

Yes, the standard Westinghouse Fluorescent lamp lasts for years in the average home. In fact, based on the rated life of 7500 hours this means 3½ years in an office or factory.

And these long-life fluorescent lamps are available in the "De Luxe" colors—thus giving you soft, natural light to enhance complexions and bring out true colors in fabrics.

For details contact your Westinghouse lamp supplier or write Westinghouse Lamp Division, Bloomfield, N. J.

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NEW

You need it! Send for free copy today!

United States Rubber Company, the only electrical wire and cable producer to grow its own natural rubber and to manufacture its own plastics and synthetic rubber, makes a complete line of electrical wires and cables for every industrial and domestic application. Just published is the 1953 "U.S." Catalog, essential for men who specify, install or maintain electrical wire and cable. Send for your free copy to address below. Here are the catalog chapter headings:

1. U.S. Royal Portable Cords and Cables
2. U.S. Railroad Wires and Cables
3. U.S. Power Cables
4. U.S. Control and Signal Cables
5. U.S. Building Wires and Cables
6. U.S. Bare and Weatherproof Wires
7. U.S. Flexible Cords and Cord Sets
8. U.S. Telephone Wires and Cables
9. Miscellaneous U.S. Wires and Cables
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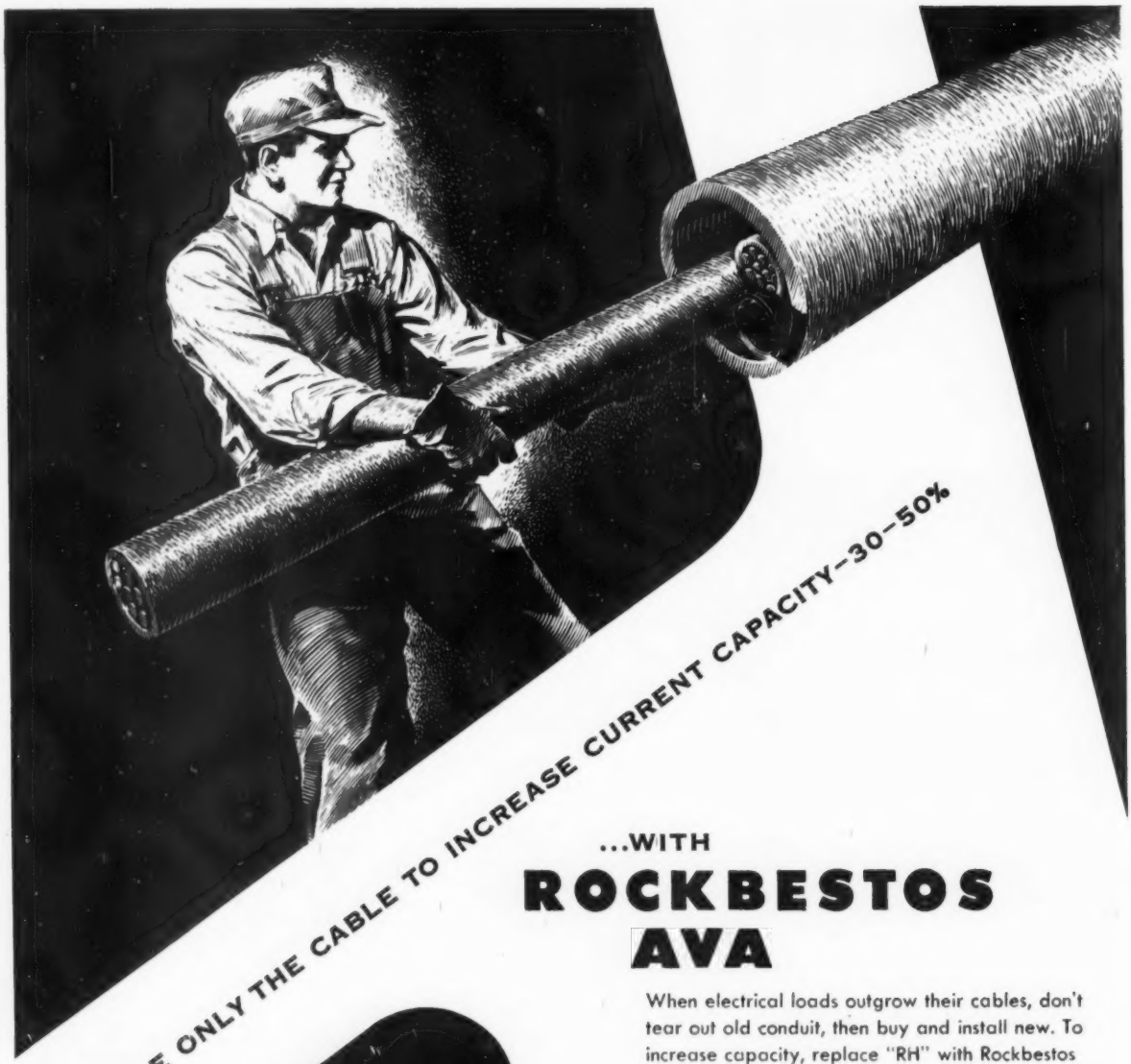
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE AND CABLE DEPARTMENT • Rockefeller Center, New York 20, N. Y.



CHANGE ONLY THE CABLE TO INCREASE CURRENT CAPACITY—30–50%

...WITH

ROCKBESTOS AVA

When electrical loads outgrow their cables, don't tear out old conduit, then buy and install new. To increase capacity, replace "RH" with Rockbestos AVA (AVC) — the cable that carries more current, size for size.

Not only do you save by putting Rockbestos AVA into existing *conduit*, but you make additional savings in labor, copper, and steel.

Used in *new* installations, you wire-in extra-capacity for future load growth, or unusual demands, with this greater-current-carrying cable.

And because it's a better insulated cable, you get more years of dependable service, too. Write for booklet "Cut Current Carrying Costs."

Inner Felted Asbestos Wall
Varnished Cambric
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Hi ... Your best buy
It's the A.V.C. "Sandwich" that makes the difference. This "sandwich" protects the varnish cambric. It enables A.V.C. to carry more current than cables with conventional insulations.
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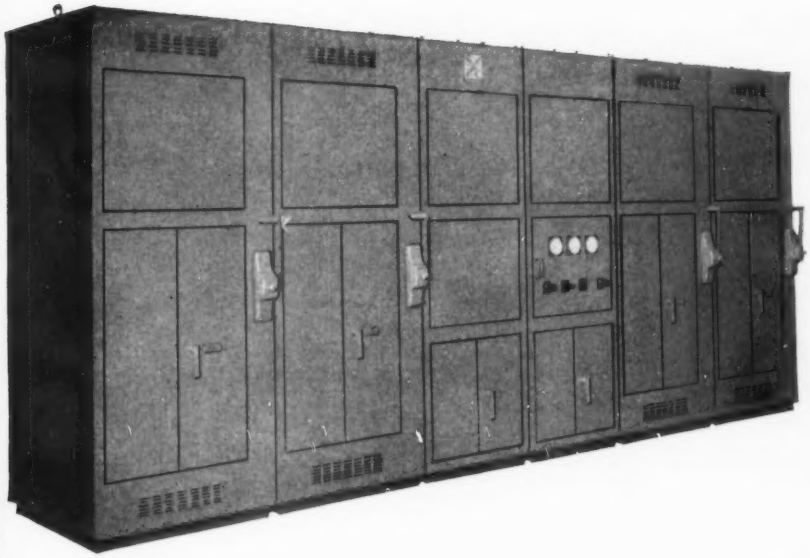
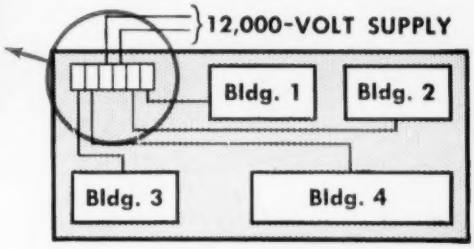
METALCLAD SWITCHGEAR PROVIDES

Low Cost Switching Centers

S&C has demonstrated time after time that expensive circuit breakers are usually unnecessary in switching centers. S&C Switchgear serves every needed purpose in high voltage industrial power distribution, at a cost usually about half that of circuit breakers.



In an aircraft plant, for instance, selection of S&C Metalclad Switchgear substantially reduced cost of the switching center. This 6-bay unit provides two separate metered sources of power, and protection for the outgoing feeders to the load centers in each of the buildings.



S&C BRINGS A NEW CONCEPT OF PROTECTION AND SERVICE

S&C equipment has been recognized by public utility engineers as "tops" for over 40 years. WHY? Because it permits greater flexibility in substation layouts—greater dependability in performance—greater convenience and safety of operation.

A new booklet on Metalclad Switchgear explains the fundamental concepts of S&C engineering, and how they affect the economics of industrial power distribution. Would you like a copy? Send the coupon.

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No. 80141—with 6¾" diameter Controlens* in removable frame. Recommended for use with 100-watt Type "A" lamp.

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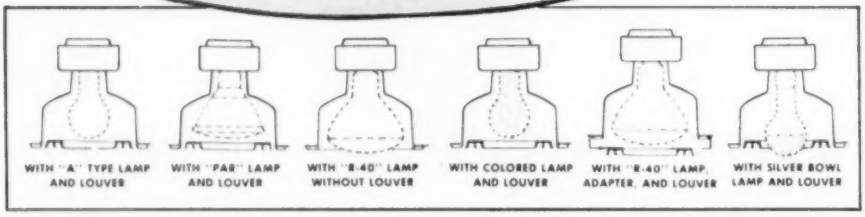
No. R-80140—with removable matt black steel louver. For PAR-38 or Type "A" lamp to 150-watt size. Without louver for R-40 lamp, 150 to 300-watt.


WITH "A" TYPE LAMP AND LOUVER
WITH "PAR" LAMP AND LOUVER
WITH "R-40" LAMP WITHOUT LOUVER
WITH COLORED LAMP AND LOUVER
WITH "R-40" LAMP, ADAPTER, AND LOUVER
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Day-Brite Derby units are low-cost, highest quality incandescent downlights. These versatile, easy-to-install recessed spots can take a lighting installation out of the ordinary class—give it sparkle and glamor—without excessive expense. And all Derby Downlights are approved by the Underwriters' Laboratories.

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Years of manufacturing experience are responsible for this outstanding tape . . . made especially to meet electrical requirements. It is thin and flexible . . . with 150% stretch. It adheres to irregular shaped surfaces, is excellent for use where space is limited. It resists weather, oils, acids and corrosive chemicals. Dielectric resistance averages 1000 volts per mil of thickness. Available in regular .007" thickness or heavy duty .010" thickness for heavy duty work—for use with power driven tape machines. Specify DUTCH BRAND Plastic Tape.

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"DB" Wire Connectors are DUTCH BRAND top quality products . . . made to exacting specifications and design. Long skirt for full insulating protection . . . made of phenolic material, they are weatherproof . . . vibration proof and resist pull-out, making perfect solderless connections. The knurled design makes them easy to handle and apply. They are available in four standard sizes, DB-1, DB-3, DB-4, DB-6.

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for PRODUCTION efficiency of your POWER SUPPLY

When building or remodeling a plant, careful thought is given to plant layout so that the ultimate can be achieved in both efficiency and production. Production flow charts, showing the proper materials handling procedures and fabrication processes and their efficient power supply are all considered in blueprint planning.

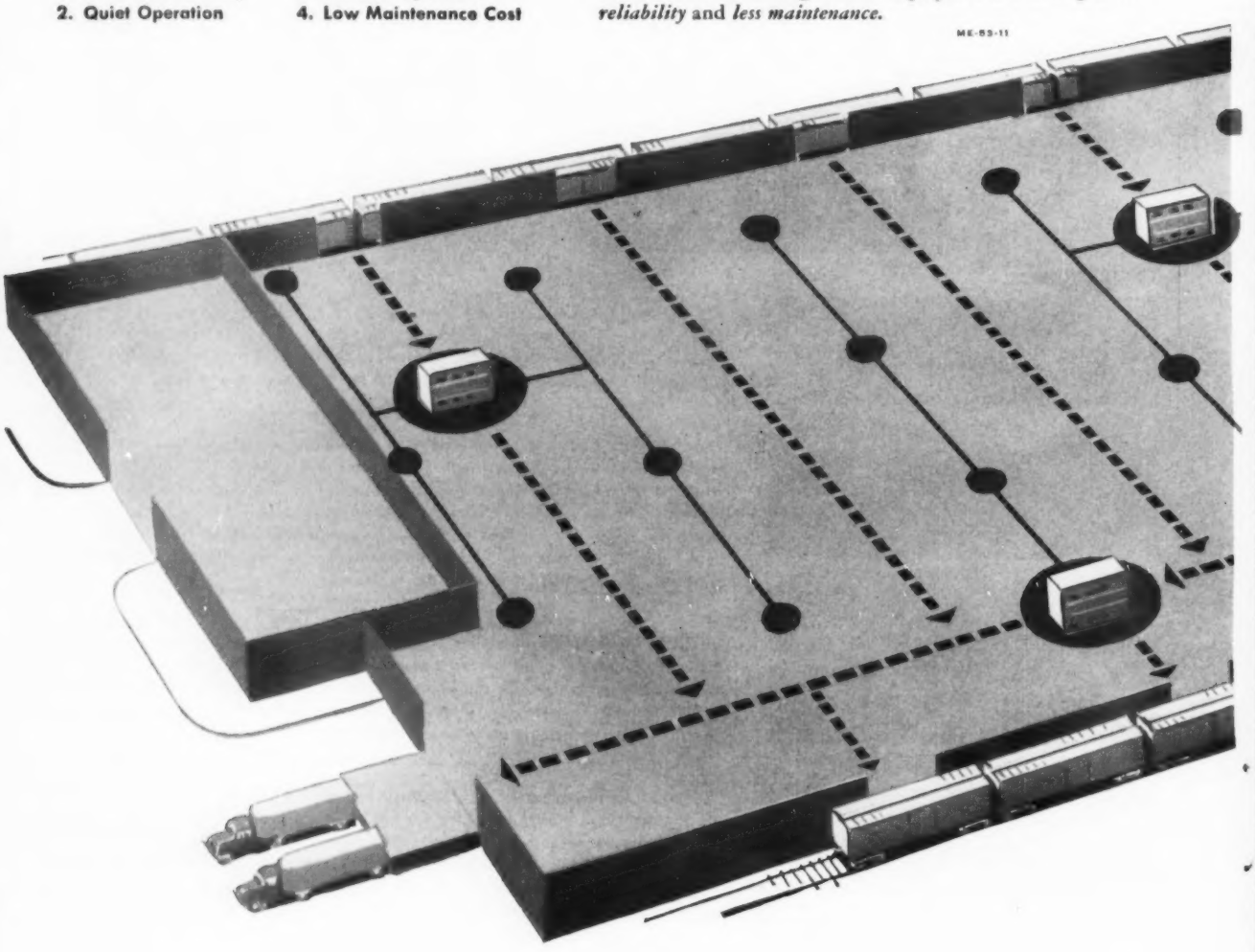
Such consideration would reveal the following features of prime importance for power supply

1. **Location Flexibility**
2. **Quiet Operation**
3. **Efficient Operation**
4. **Low Maintenance Cost**

Moloney Dry-Type Transformers will provide these features assuring you of an uninterrupted power flow under all operating conditions. Moloney Transformers also help to maintain higher levels of production efficiency for workers because of their quiet operation.

It would be wise to consider all these facts when selecting the Dry-Type Transformer to supply your power needs. If you do this, your choice will probably be Moloney . . . the transformer that gives *better performance* with *greater reliability* and *less maintenance.*

ME-53-11



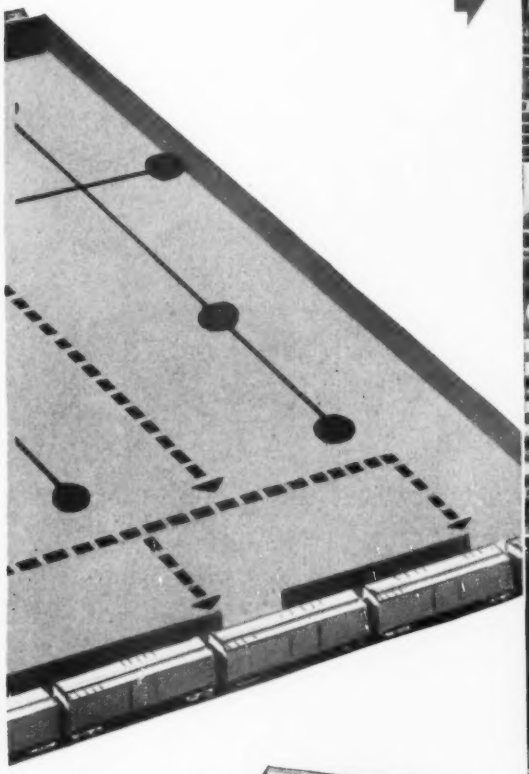
M O L O N E Y E L E C T R I C

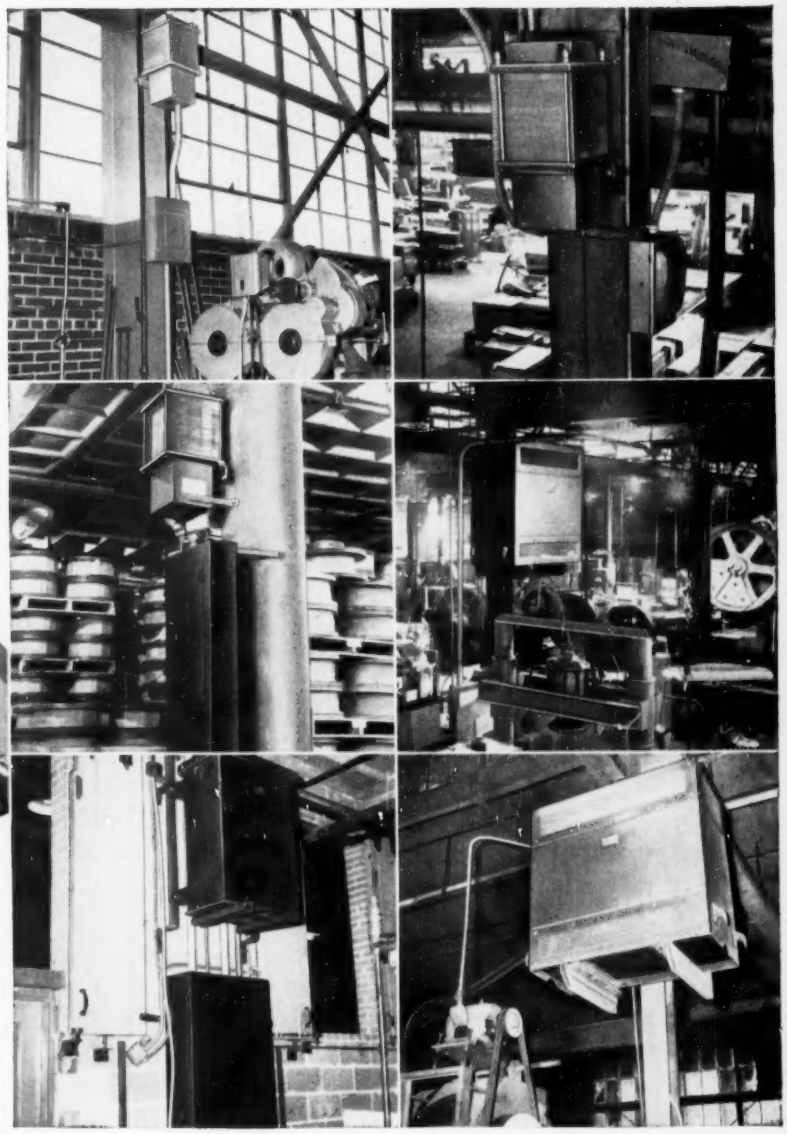
Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers

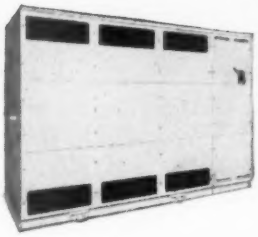
SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS

EFFICIENCY check the ... Specify MOLONEY!

Typical installations showing how Moloney Dry-Type Transformers are readily located at the most convenient point along the production line.







Moloney Dry-Type, Air-Cooled Transformer. Primary voltages range up to 15,000 volts, and sizes to approximately 3,750 Kva. Class B insulation (80° C. rise) is used.

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Step Voltage Regulators • Unit Substations

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BELLS . . . for all heavy duty signaling and alarm purposes . . . unsurpassed for volume of sound, ease of installation, long life and clean design.

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AUTH POWERBELS represent the latest advances in bell design and provide the most complete line of heavy duty bells available today.

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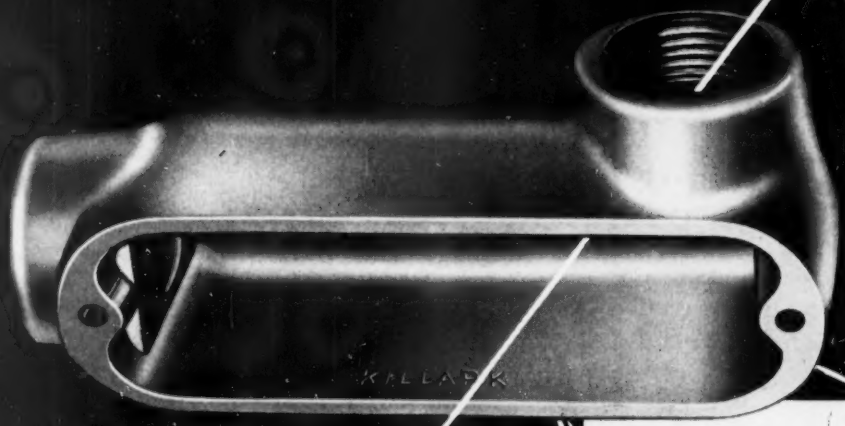

Quality is a set of characteristics that go well beyond the surface. For KILLARK, it literally means "clear-through" dependability: Solid Alumalloy construction for a lifetime of corrosion-proof service with satin-smooth finish for attractive appearance.

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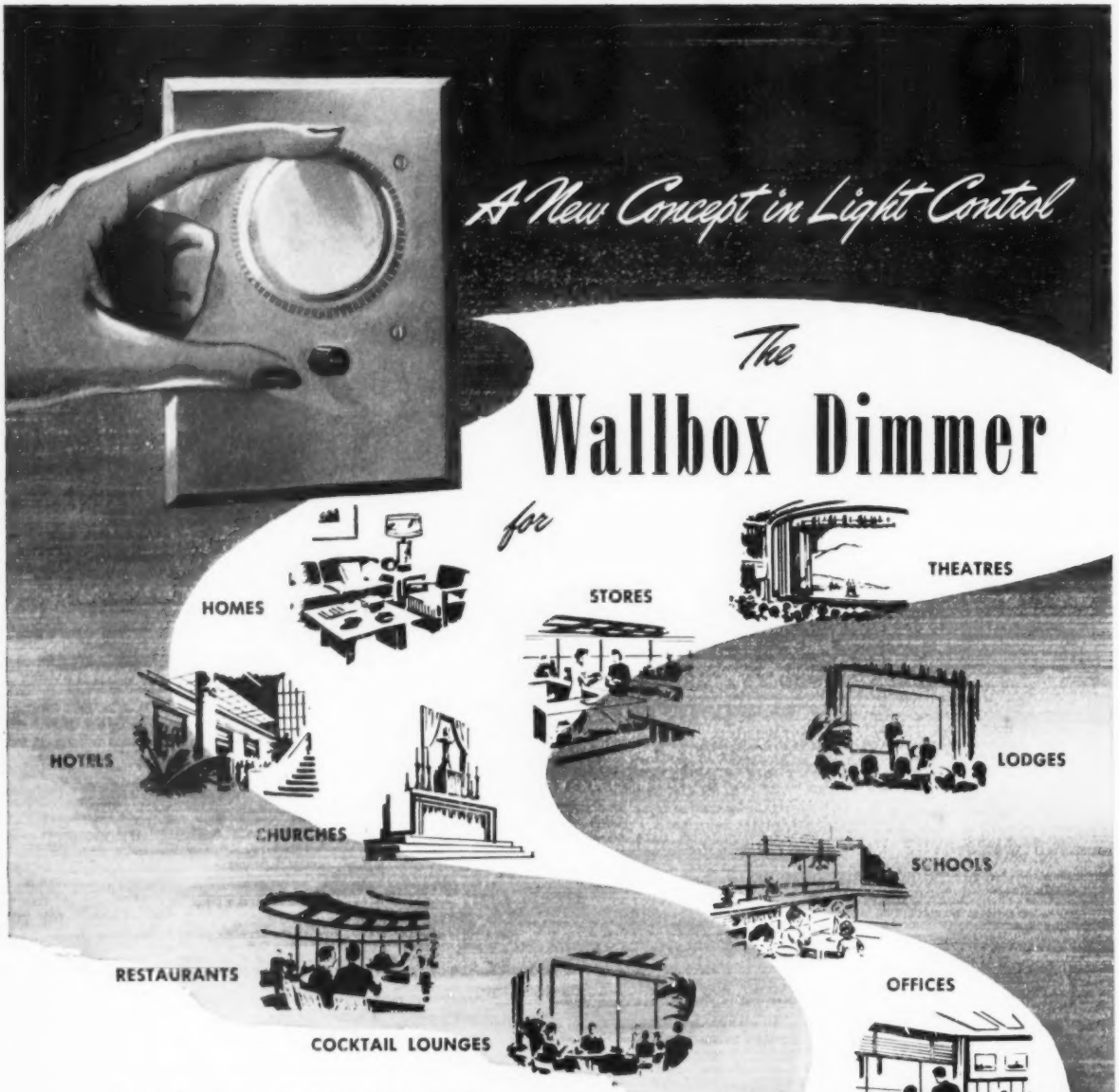

Designed to replace the light switch in a wall . . . to permit the selection of any light value from blackout to full brightness, the WALLBOX Dimmer offers a new concept in lighting control. By simply turning a knob, light just right for every occasion, any activity, is at your finger tips. It is a transformer. . . cool, efficient and economical in operation . . . controlling by converting watts. Unlike resistance type controls, it does not dissipate power dangerously and wastefully in the form of heat.

Any number of lights up to the full rated capacity of 360 watts can be controlled; no tailoring to the job is required. For complete safety, a fuse and a bi-metallic thermal overload relay are provided.

Approved by UNDER-WRITERS' LABORATORIES

GET COMPLETE INFORMATION *Send now for your copy of WALLBOX Dimmer Bulletin D1052WBT. Also available for your customers is WALLBOX Dimmer Bulletin D253WBC, written in easy-to-understand, non-technical language.*

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Every day, more and more electrical engineers specify neoprene-jacketed cable for underground distribution systems. In ducts, neoprene-jacketed cable is ideal because its light weight and flexibility assure simplified installation and lower labor costs. Tough and durable, neoprene stands up under rough handling around manholes and ducts . . . withstands the effects of lubricants. Even grease and oils that may be present in old ducts present no problem.

Buried directly in the ground, neoprene resists attack from soil acids and stands up under crushing from settling earth. Unlike metallic coverings, it is not damaged by electrolytic action caused by stray currents.

Your supplier is the man to see for more information about neoprene-jacketed cable. It is available in single and multiple conductor types, in voltage ratings to meet your requirements.

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"With Westinghouse transformers we don't worry about costly shutdowns!"

A heat-treating furnace located in a crowded production area at Marlin-Rockwell Co. needed economical and reliable power close to the load. Mr. Merville Pineo, Engineer in charge of maintenance, made this statement—

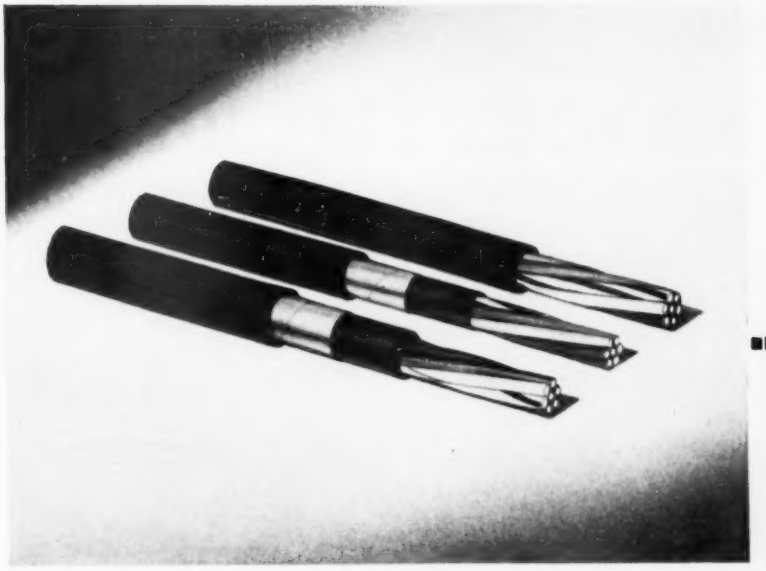
"Any transformer failure would be extremely costly to us, inasmuch as it would shut down the furnace. We've had no power breakdown with Westinghouse transformers. I have a high regard for Westinghouse transformers because of their dependability and minimum of maintenance requirements. During routine checkups, we've found they're easy to get into . . . and you'll never find a maintenance engineer who will complain about that!"

On-the-spot power was possible with Westinghouse dry-type transformers because they are small and light enough to be mounted on an overhead platform. Long, high-cost secondary runs are eliminated—valuable floor space saved.

Westinghouse dry-type transformers may solve a problem of yours—at impressive savings in installation and maintenance. Call in your Westinghouse representative—he'll be glad to talk with you. Or write for booklet B-5812, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70667

YOU CAN BE SURE... IF IT'S

Westinghouse



THESE THREE ARE "A NATURAL"

for LOW COST, TROUBLE-FREE OPERATION of SIGNAL, CONTROL and COMMUNICATION CIRCUITS

Here's a list of the top quality benefits you get when you buy Simplex Polyethylene-Plastex Signal Cables. For more complete information send for our newly-revised Simplex catalog #1010 in care of the address below.

POLYETHYLENE INSULATION

- High Dielectric Strength
- Low Dielectric Constant
- Low Power Factor
- High Insulation Resistance
- Good Physical Properties
- Low Water Absorption
- Resists Oils, Chemicals, Sunlight, Aging
- Low Cracking and Shattering Temperatures
- Resists Deformation
- Permits Use of a Thin Wall

PLASTEX JACKET

- Tough yet Flexible
- Low Cracking Temperature
- Wide Temperature Range
- Resists Abrasion, Oils, Chemicals, Flame, Sunlight, Aging
- Low Water Absorption and Diffusion

COMPLETED CABLE

- Small in Diameter
- Light Weight
- Low Capacitance and Attenuation
- Electrical and Mechanical Stability
- Comes in Three Types Shown Above for Duct, Underground and Aerial Service

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DOW CORNING SILICONES

make coils last longer

$25 invested in Class H Saves $500; makes city water supply more certain

Half of Philadelphia's water supply is handled through the Torresdale Raw Water Pumping Station by six 60,000,000 gallon per day centrifugal pumps driven by 2300 volt, 500 hp motors. These motors are controlled by oil filled circuit breakers. Trouble was that the circuit breaker coils had an average life of only 3 months; cost the taxpayers $50 every time a new coil was installed.

So to save taxpayers' money and secure more continuous and reliable operation of pumping equipment, department engineers had these coils rewound with Class H insulation at an additional cost of $25 per coil. That was 30 months ago. Not a single coil has failed to date, and that's already 10 times the average life of previous coils. Represents a saving of $500 per coil; a net saving so far of $3000 less the original investment of $150.00 in Class H or $2850.

That's the kind of performance and the brand of economics that has persuaded a steadily increasing number of engineers and top management men to specify Class H insulation made with Dow Corning Silicones. In thousands of applications from subminiature electronic circuits, through traction motors, generators and transformers to industrial motors ranging from 1/8 to 1000 hp, Class H insulation has given 10 to 100 times the life of comparable equipment built with the next best class of insulating materials.

Increase efficiency; cut production and maintenance costs; specify silicone (Class H) insulation.

***NOTE:** New Dow Corning Silicone Resins are now available to give you unequalled freedom in design—still more power per pound—even longer life and greater dependability. Write for data on the new Dow Corning 994 Varnish for coating; Dow Corning 997 Varnish for impregnating; and Dow Corning 2105 Resin for bonding.*

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- ☐ List of Class H Rewind Shops
- ☐ Data on Dow Corning 44 Grease for bearings
- ☐ Data on Dow Corning 994 Varnish
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In Great Britain: Midland Silicones Ltd., London

In electrical installations *where QUALITY counts* use CONDULETS*

Quality does count in practically every electrical conduit installation that you make. When you use CONDULETS you know that you are putting in electrical equipment of the highest quality, because CONDULETS have been doubly tested . . . in the factory and in the field.

Crouse-Hinds quality control assures a long-lasting product and field records prove it by the test that only time can give. Thousands of CONDULET installations are still in tip-top condition after twenty, thirty, or even more than forty years of dependable service.

The illustration at the right shows four of Crouse-Hinds' basic quality features that are common to all CONDULETS. The fifth, Wedge Nut Fasteners, is an exclusive Crouse-Hinds feature that has made Obround CONDULETS preferred by electricians everywhere.

1. **Taper tapping.** Condulet threads are taper tapped to match tapered conduit threading. Makes a rigid joint that will not loosen. This assures permanent ground continuity . . . important for safety.
2. **Integral bushing.** A smooth rounded surface protects wire insulation.
3. **Material.** Feraloy . . . a special alloy that is strong and tough, resists corrosion, and gives sharp, full threads
4. **Finish.** A triple treatment provides long-lasting protection . . . exceeds Federal and U. L. specifications.
5. **Wedge Nut cover fastener.** Clear cover opening . . . no projections. No loose parts . . . Wedge Nuts and screws self-retained. No screw holes to align.

More than 15000 items are listed in the Condulet Catalog including a complete explosion-proof and dust-tight line for use in hazardous locations.

On your next job, use CONDULETS . . . they're made right to last longer.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

Type EVA Explosion-Proof Lighting Fixture

Type ARE Arktite Receptacle Equipment

Type FS Condulet With Pilot Lamp Receptacle, Switch and Plug Receptacle

Type GUAC Explosion-Proof Junction Condulet

Type VC Vaportight Industrial Lighting Fixture

Type FLB Explosion-Proof Circuit Breaker Condulet

Type EPC Explosion-Proof Motor Starter and Circuit Breaker Condulet

A Nationwide Distribution Through Electrical Wholesalers

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Syracuse 1, N. Y.

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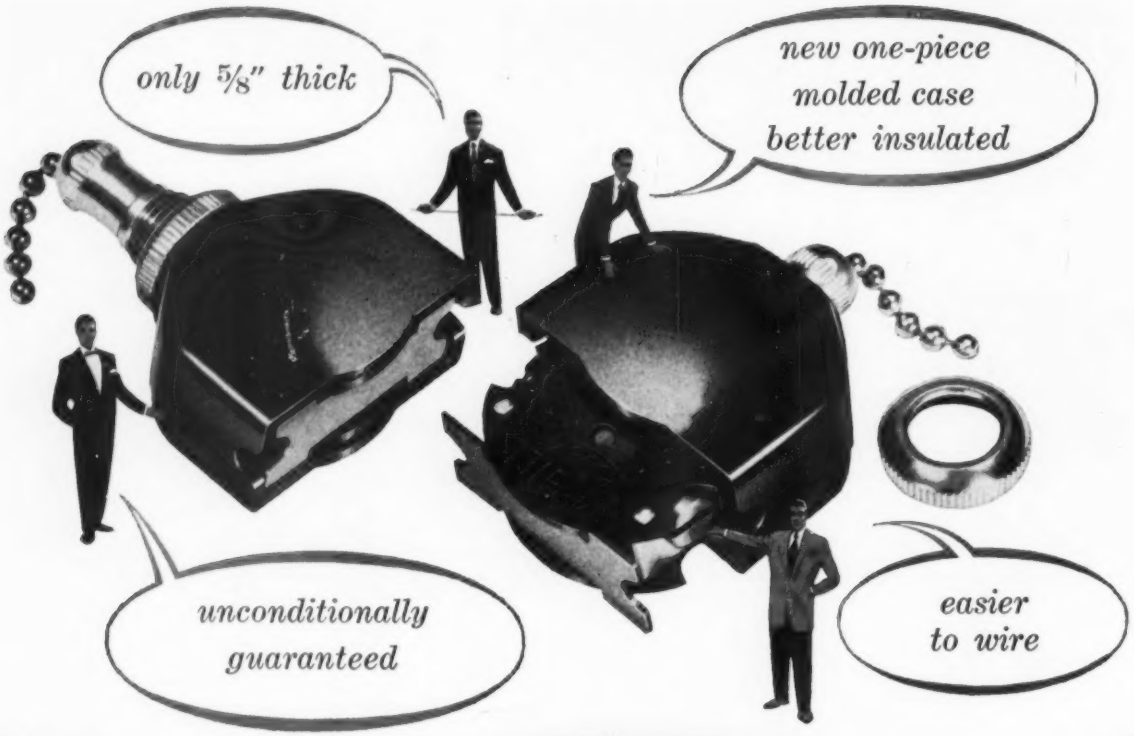
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS



now *unconditionally guaranteed no. 41* ***Levolier®*** *switch*

improved with new one-piece phenolic case

You can save money by specifying the Model 41 Levolier Switch because its use eliminates the need of replacement and reduces maintenance costs. It is the only switch unconditionally guaranteed against failure in lighting circuits. And now the Model 41 has a new rugged one-piece molded Phenolic case that provides better insulation and makes wiring easier and faster. Requires only removal of mounting nut to slip mechanism out of case and wire easily accessable terminals. Insert in case, slip lever through mounting means and replace nut. It is a 6 amp, "T", 125 volt; 3 amp, 250 volt switch, only 5/8" x 1 3/8" x 1 3/8". The No. 41 insures dependable lifetime service for conduit box and canopy mounting, incandescent or fluorescent lighting and for FHP motor control. *Underwriters' Laboratories Inspected.*

Send for the new McGill Catalog No. 49-A describing the full line of Levolier Switches, Sockets and Lamp Guards.

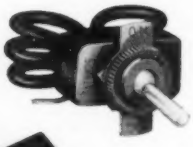
McGILL®
electrical specialties

McGILL MANUFACTURING COMPANY, INC.
450 N. Campbell St., Valparaiso, Indiana

model 1010
10A "T" 125V

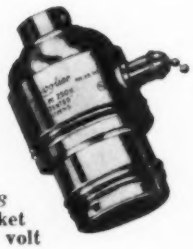
model 71
6A "T" 125V

all are McGILL® quality



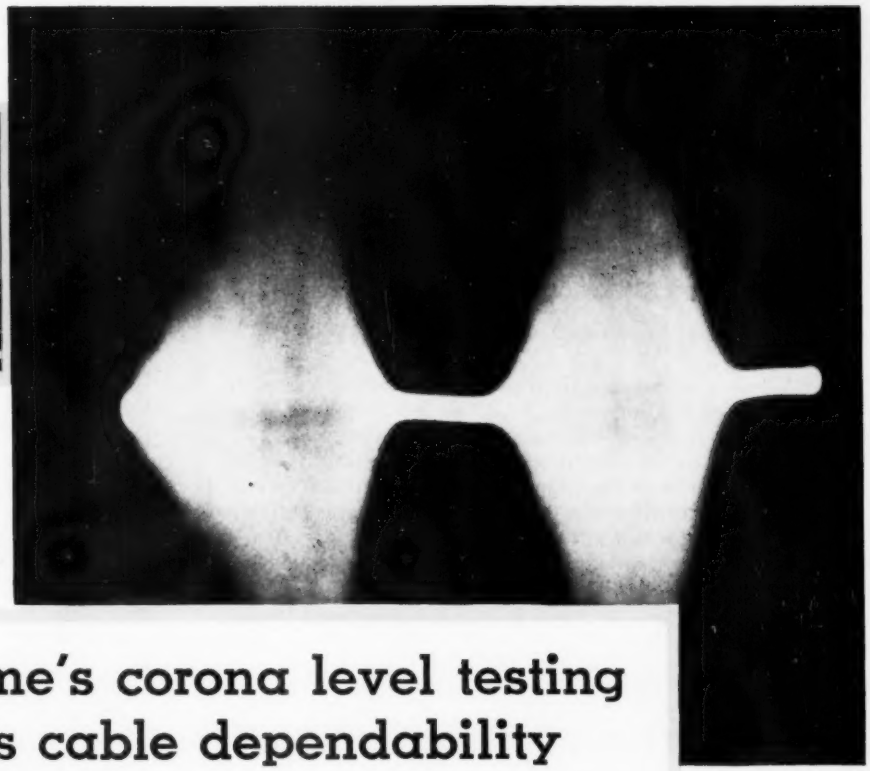
model 25
6A "T" 125V
Colored plastic levers

model 2020
20A 125V



4100 series
Industrial socket
600 watt — 250 volt

Specially designed ionization detector for routine factory use measures corona level of all-insulated cables rated at 3000 volts or over.



Why Rome's corona level testing assures cable dependability

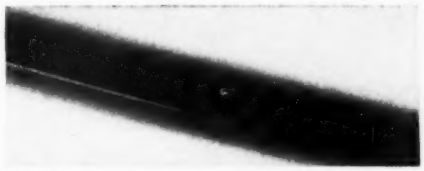
The picture above means trouble. It is an oscilloscope trace of internal ionization in an insulated cable.

Ionization is caused by the electrical break-down of air in pockets within the insulation, or especially where it has not been firmly bonded to the conductor surface or shield. Should this ionization occur at a value below the operating voltage of the cable, several destructive electrical effects may occur such as possible ozone cutting, reduced dielectrical strength, and a substantial increase in dielectric losses. Any of these hazards could result in early failure or reduce the efficient performance life of the cable.

Ionization is particularly dangerous because it cannot be detected by the ordinary visual, physical and electrical testing methods usually applied to cable.

So, to prevent guesswork, to assure you of maximum protection against ionization, *every foot of Rome insulated cable, rated at 3000 volts or over, is thoroughly tested by a specially designed ionization detector.* This instrument accurately measures the corona level of the entire cable. Unless the ionization voltage exceeds the intended operating voltage of the cable, the cable is rejected.

This is one more extra step in Rome Cable's standard manufacturing procedure that assures dependability. This completely new *NONDESTRUCTIVE* method of testing was developed by Rome Cable engineers and was first described in AIEE paper 48-198, "The Measurement and Investigation of Ionization Level of Rubber Insulated Cables," presented in August, 1948.



This X-ray reveals loose insulation—a major cause of ionization.

500,000 CM stranded single conductor RoZone insulated, shielded, RoPrene sheathed power cable . . . 15,000 volts, grounded neutral.

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA

ROME CABLE CORPORATION, Dept. EC-5, Rome, N. Y.
Please send me a copy of ..... AIEE paper 48-198
..... Rome Power and Control Cable Catalog.

Name .....
Company .....
Address .....
City ..... Zone ..... State .....

for the most in time switch value
choose a Sangamo!

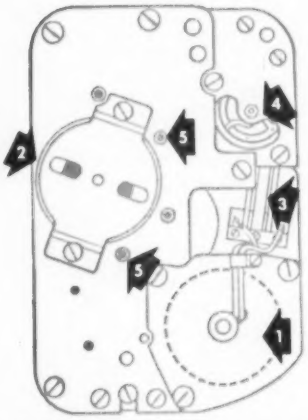
ONLY SANGAMO OFFERS

AUTOMATIC CARRYOVER

IN EVENT OF POWER FAILURE

When you install a time switch in a remote or hard-to-reach location—your best buy is a Sangamo Type W—the synchronous carryover time switch. Type W never requires re-setting after a power failure, unless the power is off for 10 hours or more. You don't even have to rewind the mainspring of the carryover mechanism—it's *entirely* automatic.

Think of the unnecessary service calls that you've been making after power outages—and choose a Sangamo Type W Time Switch for your next "hard to get to" installation. It will save you time and money.



Back view of Type W operating mechanism, with dust cover removed.

here's *Double Protection* against trouble

There's inherent protection against trouble in all Sangamo Time Switches. The *slow* speed motor . . . The heavy-silver contacts . . . The overall built-in *values* of Sangamo Switches provide protection against ordinary trouble. When you add the protection against outages that the Type W affords—you've got a sure winner.

1. **Sangamo synchronous 450 RPM motor with secondary coil—always ready to "carry over" to mainspring operation.**
2. **Electrically wound main spring—ready to provide 10 hours reserve power.**
3. **Bimetallic spring that blocks escapement when switch is operating synchronously.**
4. **Jeweled escapement to keep accurate time during current interruptions.**
5. **Bronze bearings at points of greatest wear for longer service life.**

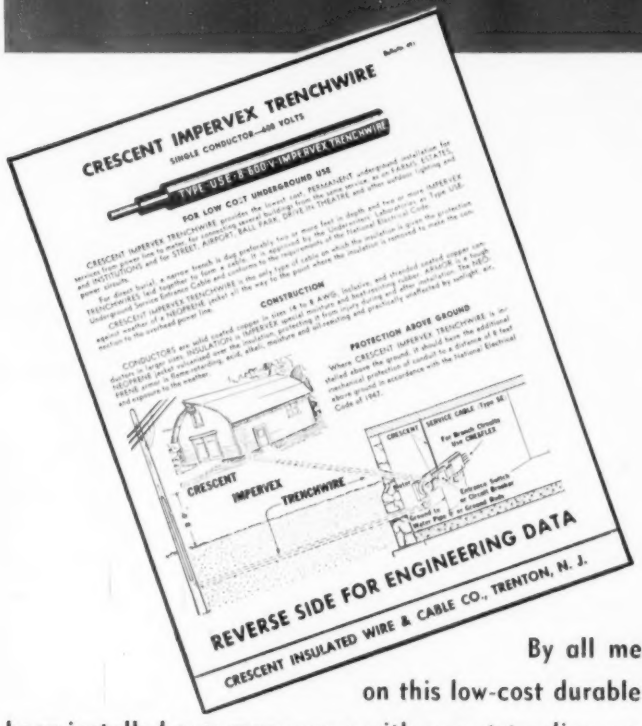
SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

* Your electrical wholesaler can furnish all types of *dependable* Sangamo Time Switches. See them before you specify the time control for your next installation. Bulletin 1010 tells the full story—write today.

for your most exacting installations

ST53-3

This Bulletin tells you what you want to know



about LOW COST TRENCHWIRE

for underground use

Now is the time to be thinking of spring business. Get all the information you can NOW on the advantages of

CRESCENT IMPERVEX TRENCHWIRE

Approved by Underwriters Laboratories as Type USE Underground Service Entrance Cable. Conforms to N.E. Code.

By all means, you should have *complete information* on this low-cost durable wire, of which tens of millions of feet have been installed over many years with an outstanding record of service.

This Bulletin gives you readily understood, technical information on the selection of the proper size of conductor, method of installation, etc. Your files are not complete without it.

CRESCENT endorses and supports the NECA idea. All CRESCENT Wires and Cables are covered by the company's standard guarantee, covering material and workmanship. You may safely add your own guarantee whenever you install CRESCENT Wire.

SEND FOR BULLETIN No. 491

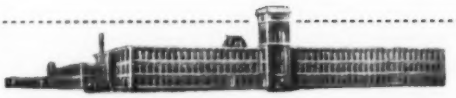
CRESCENT
WIRE & CABLE

OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.

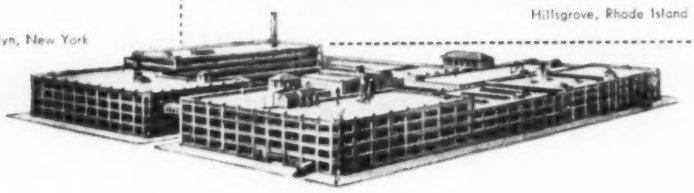
TRENTON, N. J.

American Insulated Wire Co.
Pawtucket, Rhode Island

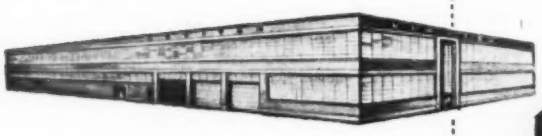


Hillsgrove, Rhode Island

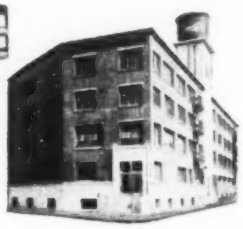
Brooklyn, New York



three great plants...



Chicago



Los Angeles

two strategic warehouses...

and **...in Canada**
Leviton (Canada) Ltd.
Montreal, Quebec

one purpose...to assure you an adequate supply of...

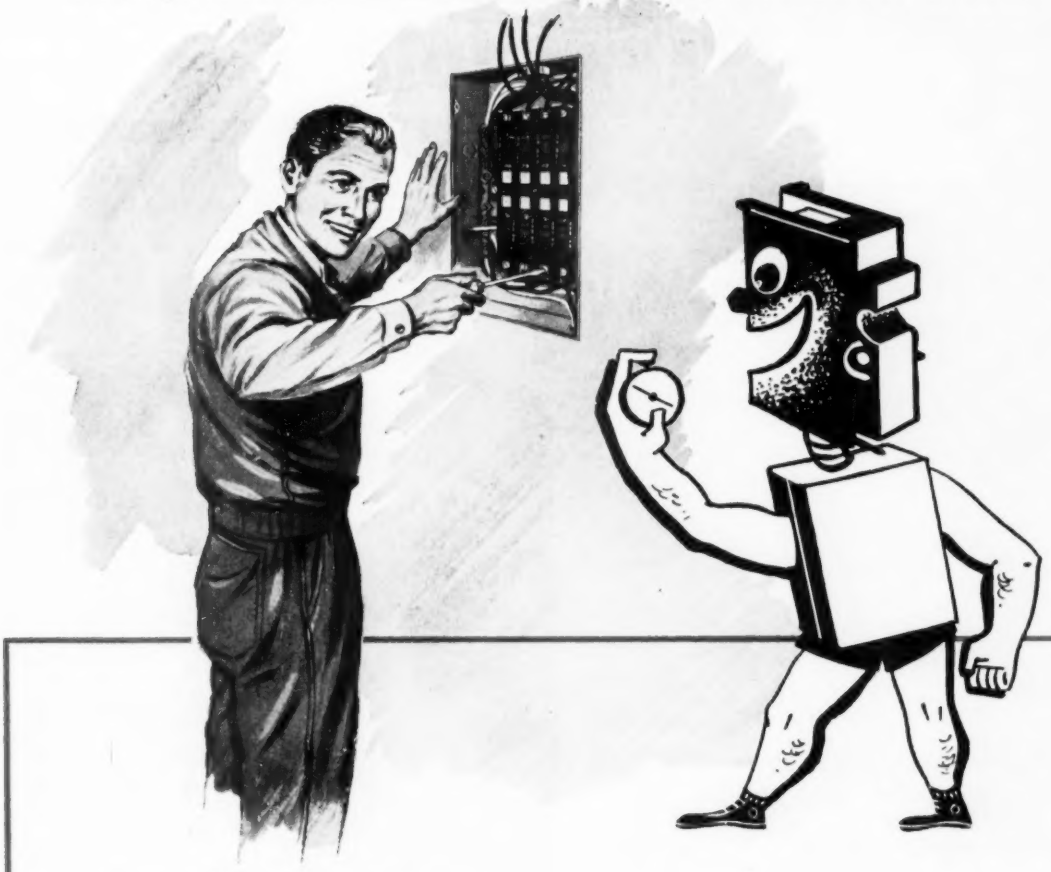
LEVITON

...quality wiring devices and wire

LEVITON MANUFACTURING COMPANY main office: Brooklyn 22, New York • Offices in all principal cities

The contractor thought it was silly...

till he proved to himself the ***Stab-lok*** *system costs least to install*



REPORT OF INTERVIEW WITH CONTRACTOR:

Q—We understand you compared the time to install different circuit breakers. What was the result?

A—It wasn't even close! Stab-lok was way out ahead. Stab-lok is so much quicker to install that it cuts labor costs way below other systems.

Q—What are the special features that speed up Stab-lok installation?

A—Well, first, Stab-lok plug-in type individual pole breakers provide the quickest method of securely connecting breakers to busses. Second, Stab-lok's solderless lugs give you today's simplest and fastest form of connection. Then, too, Stab-lok's lug type neutral saves the bother of wire looping... and removable main lugs, in the larger devices, save time when installing main conductors.

* * *

Besides these four features, there are still others that make Stab-lok least costly to install... easily removable interiors... large gutter space... conveniently located knockouts... simplest adjustment to plaster level on flush enclosures.

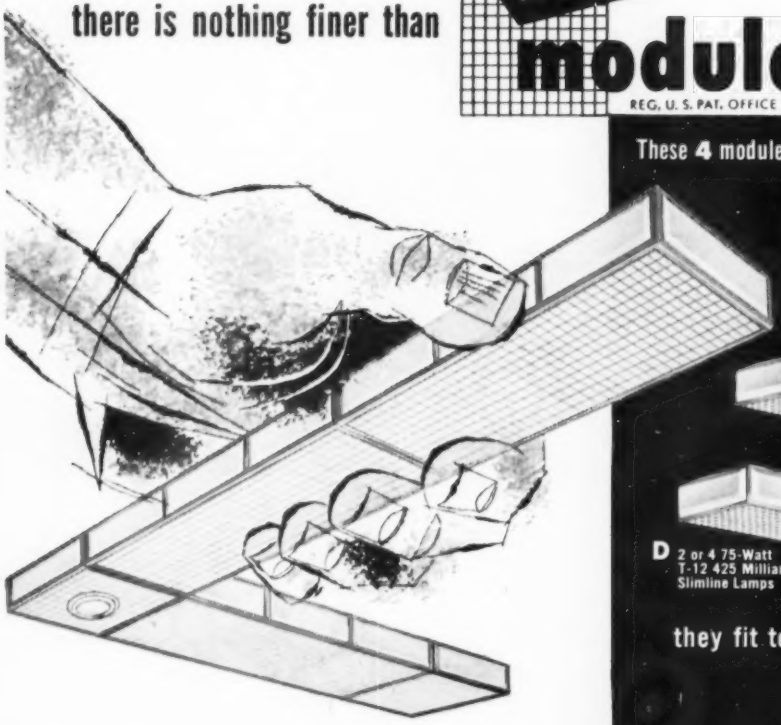
In addition, Stab-lok is the most modern, complete and flexible circuit protection system on the market. Write for full information, and order Stab-loks from your distributor. Federal Electric Products Company, 50 Paris Street, Newark 5, N. J.

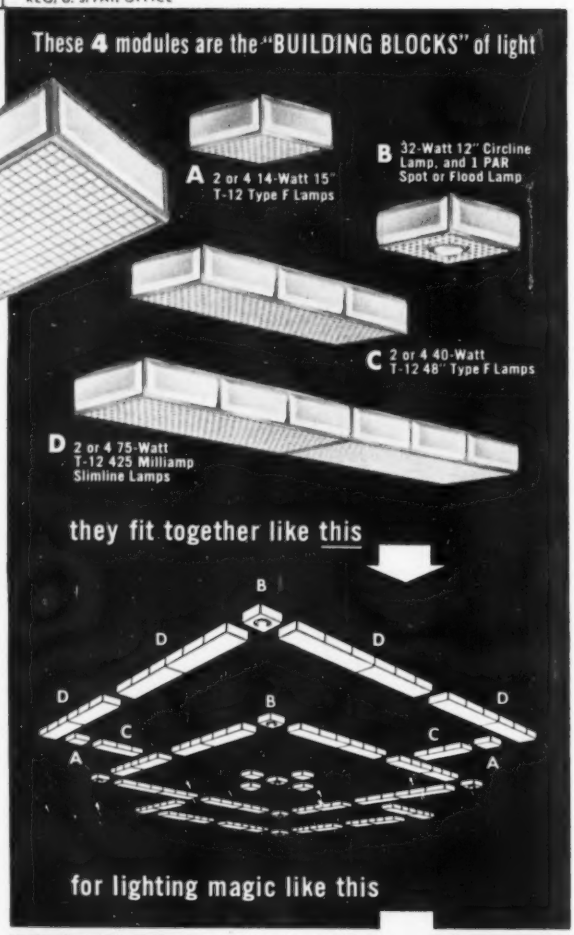
Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

FEDERAL NOARK®

Where the installation calls for exceptional commercial lighting

there is nothing finer than **MITCHELL module** REG. U. S. PAT. OFFICE




These 4 modules are the "BUILDING BLOCKS" of light
A 2 or 4 14-Watt 15" T-12 Type F Lamps
B 32-Watt 12" Circline Lamp, and 1 PAR Spot or Flood Lamp
C 2 or 4 40-Watt T-12 48" Type F Lamps
D 2 or 4 75-Watt T-12 425 Milliamp Slimline Lamps
they fit together like this
for lighting magic like this

custom-fits *any commercial interior—at no more than the cost of ordinary fixtures*

50,000 DIFFERENT PATTERNS POSSIBLE
20% MORE LIGHT

When you specify MITCHELL MODULE, you specify *the best* in ultra-modern commercial lighting. It's a revelation: with just 4 simple, low-cost "building blocks of light", MITCHELL MODULE offers *unlimited* lighting patterns to custom-fit any commercial interior. MODULE'S exclusive plastic louver passes 20% MORE LIGHT. Units fit together simply (mechanically and electrically) for quick, low-cost installation, and for easy rearrangement of patterns to suit changing needs. MODULE mixes all light sources smoothly in one harmonious, beautiful system—puts the light exactly where it's needed. No ordinary fixtures can match MODULE—the *only* lighting that *custom-fits* with standard *low-cost* units.

Only MITCHELL makes MODULE

There's nothing in lighting easier to specify, easier to sell than MODULE. It custom-fits and "grows" with every lighting need; it delivers MORE LIGHT; it stays beautiful, new; it costs no more than ordinary fixtures. It's America's No. 1 Commercial Lighting with exclusive advantages for architects, wholesalers, contractors, utility consultants and users. You'll want the facts about MODULE—write today for full descriptive catalogs.

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ANACONDA FORUM
for the Electrical Industry

THE IMPORTANCE OF PRODUCTION METHODS ANALYSIS IN INDUSTRY

by Robert G Ely, Vice President
The Connecticut Light and Power Company

LOWER production costs, always a major concern of industrial management, have, due to inflationary pressures during the past several years, become the vital element of survival in our competitive markets. Fortunately better production methods, coupled with enlightened depreciation practice that provides for prompt replacement of obsolescent productive equipment, enable our industrial customers to stay in the race. And fortunately, America's engineers are past masters at continually developing better production methods. The pioneering work of Dr. Frank Gilbreth in time and motion study laid the groundwork for a fascinating field of engineering encompassing the fundamentals of continued profitable operation in any industrial activity—that of Production Method Analysis.

FROM RAW MATERIAL TO FINISHED PRODUCT

Production Method Analysis studies the operation from raw material to finished product—the method of handling materials, the sequence of operations and their logical physical relationships, the individual operators and their activities. It also studies bottlenecks of production, such as poor or obsolete equipment, inadequate wiring with its consequent voltage problems and decreased production rates, inadequately trained personnel, or lack of proper tools. In short, Production Method Analysis breaks down apparently complex operations into their simple component parts. From such analyses and the subsequent use of modern, high-speed, automatic machines properly tooled and in proper sequence, along with effective materials handling and efficient personnel who know their jobs, comes the healthy industrial employer who is so vital to the well-being of the community and, incidentally, to the utility serving that community. And therein lies our very real interest in Production Method Analysis.

INDUSTRIAL PAYROLLS VS. UTILITY INCOME

There is no mathematical sleight-of-hand involved in developing the relationship of industrial payrolls to utility income in any community or group of communities. Unable to pull up poles and move to where the grass may look greener, and confined to its franchise territory in its quest for new business, the utility's prosperity directly reflects the general prosperity of its service area. Lower production costs, therefore, become of vital concern to us as well as to our customers. Production Method Analysis as a tool in increasing production rates and reducing unit costs has therefore become part of our vocabulary, part of our thinking, part of our program of doing our utmost to help our manufacturers maintain and improve their competitive positions within their own industries.

ELECTRICAL EQUIPMENT PLAYS A PART, TOO

Our allies in the electrical equipment field have an important part in this program too. This is for the reason that better production methods depend on the availability of a sufficient supply of power in the right place at the right time, ready for application to the job of increasing the effectiveness of manhours through efficient transformation into mechanical or heat energy for the accomplishment of industrial tasks. Generating stations, transmission and distribution systems, adequate plant wiring and well engineered utilization equipment are all necessary parts in the over-all picture of industrial and community growth and health. All who have a part in the supply of these facilities strengthen the backbone of better production methods.

ANACONDA JOINTING KITS prevent the possibility of inadequate materials . . . keep stocks fresh and readily available for fast withdrawals. Illustration shows how complete these kits are—right down to a handy checklist of materials.

ANACONDA CABLE ACCESSORIES

A complete line—engineered by power-cable experts—is available in increased quantities.

At Anaconda, the increase in demand for cable accessories is being met by increased production. The complete line—with many exclusive features—consists of the following:

Potheads (capnut, switchgear, transformer, disconnect and through types), featuring unmatched interchangeability of parts.

Unit Packages of Jointing Materials. These kits contain everything needed to make a joint.

Filling Compounds. Balanced compounds mean greater stability.

Cable Paints and other miscellaneous accessory items.

Bring your cable and cable accessories problems to your Anaconda Representative.

Durasheath

the *all-purpose* ANACONDA Cable for both power and lighting services

Durasheath's* tough neoprene jacket stubbornly resists electrolysis, corrosion, temperature extremes, cutting, abrasion, impact, flame, oil, grease, moisture and most soil acids and alkalies.

Run it overhead, in ducts, or buried underground—or all three in one continuous run.

It's flexible, easy to handle, economical to install; made in single or multi-conductor construction.

Your nearest Anaconda Sales Office or Distributor can show you why it's good business to install this versatile, all-purpose cable. Just ask them.

*Trademark

TEN BASIC RULES FOR INDUSTRIAL WIRING

BY FRANK AIME, veteran electrical engineer of Anaconda Wire & Cable Company.

Successful operation of an industrial plant depends on the quality of its electrical distribution system. These rules should help in setting up a well-planned system for both large and small plants:

1. Design the system within supply limitations.
2. Locate supply near electrical load centers.
3. Know your load requirements.
4. Let requirements of processes, production and relative importance of the major characteristics of distribution systems determine distribution system type.
5. Select and arrange feeders and equipment so that interruptions never occur more than the process will allow.
6. Select all components from source to load for reasonable future growth.
7. Don't be limited by National Electric Code figures for conductors, conduit and protection which are minimum and primarily for safety.
8. Use load centers when feasible.
9. Select cables with best all-around characteristics for your condition.
10. Aim always for production efficiency, quality and safety.

ANACONDA RESEARCH AT WORK

How a new problem meant a new product

The problem? Loads had outgrown duct space and duct sizes of lead-covered cables. Cables had to be run hotter and under more severe physical difficulties. Cable *sheaths* were failing before *interiors* . . . cable life was limited.

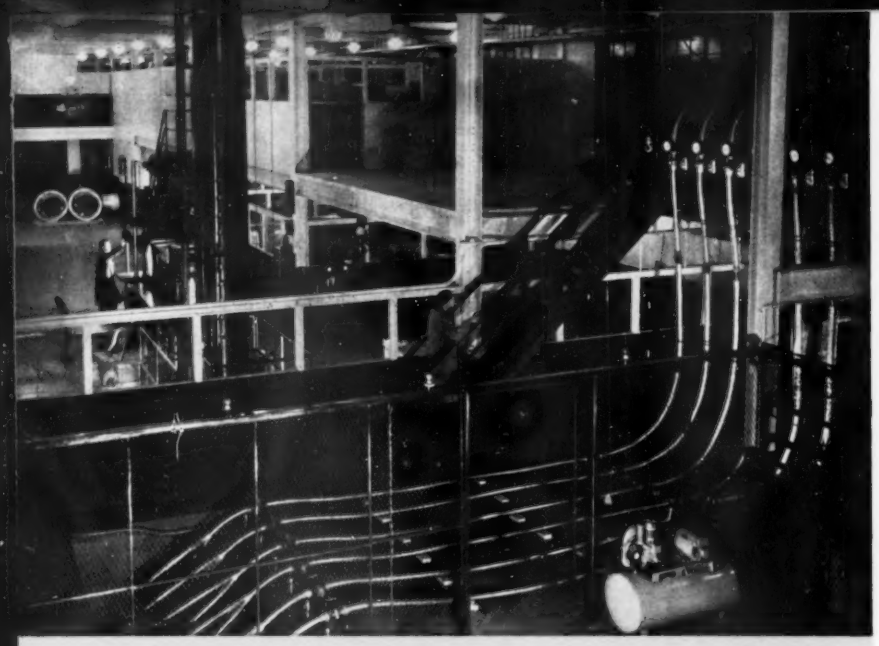
Anaconda research set out to find the answer. Hundreds of sheath alloys were tested. The one finally selected promised far better performance. Called ANACONDA F-3† alloy-lead sheath, it has a high burst strength and a low creep rate . . . resists bending and does not age-harden.

Once again, Anaconda's planned program of research solved a new problem with a new product. Yes, research like this pays off . . . in cable that serves you better!

RESEARCH IS ANACONDA'S BUSINESS, TOO!

†F-3 *Arsenic-Lead Alloy (U. S. Patents 2,300,788, 2,375,755, 2,504,600 and 2,570,501) Reg. U. S. Pat. Off.*

ANACONDA®



CYCLIC AGING TEST. Here's one method Anaconda Engineers use to learn how lead-covered, paper-insulated cables stand up. In this laboratory, cables are loaded under conditions similar to daily load cycles in the field, but at higher temperatures and voltages. Result: Anaconda Engineers get the facts fast . . . know what can happen years hence . . . and can give you much more reliable performance data.

WHY THIS MAN'S JOB MEANS BUILT-IN QUALITY IN THE CABLE YOU BUY

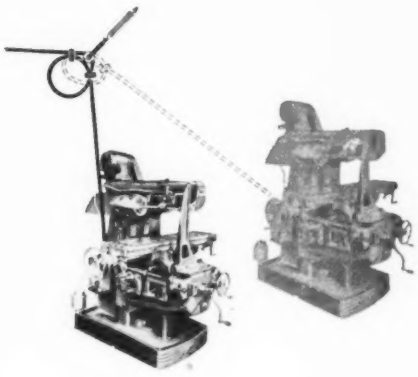
THIS IS ED GITTLESON, Anaconda's Chief Inspector and Manager of Quality Control.

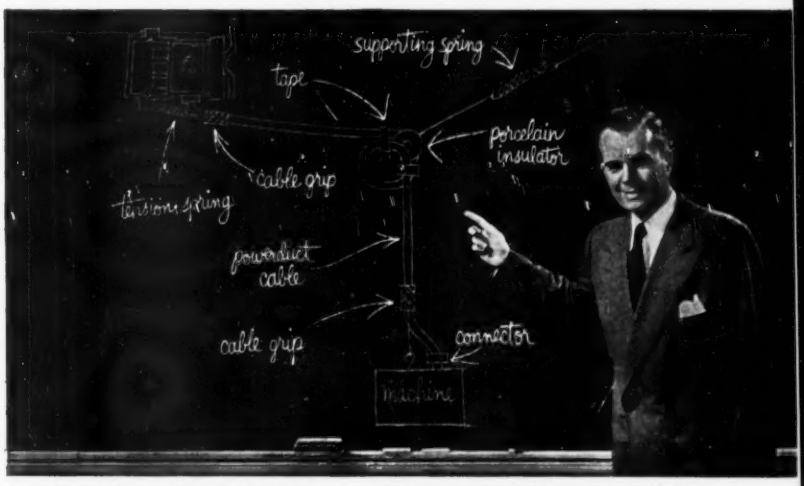
Ed knows that to make a good product and sell it at the lowest possible price, quality must be built in right from the start. That's Ed's job—to see that it's done from raw material to final shipment. Ed has based Anaconda's control program on principles of statistical quality control that assure you not only of *greater* uniformity, but of a *higher level* of quality as well. You can be sure that every Anaconda product more than complies with your requirements.

No busduct system is truly flexible without this

New ANACONDA® Powerduct Cable

It's the only nonmetallic-armored busdrop cable UL approved for this hard use; cuts cost of relocating machines.





Even if you have a modern busduct system, it may be flexible only so far as it goes. You may still have to rip out permanent or semi-permanent wiring every time you rearrange important machines. That's costly.

Why not match your busduct system with money-saving ANACONDA Powerduct Cable . . . approved by Underwriters' Laboratories, Inc., for busway branches under section 3646, 1951 National Electric Code?

Powerduct Cable is much cheaper to install than conduit. It handles easily. Grips prevent cable creep. No time is lost. You get circuit capacity at any point for any load at any time. Coil (see illustration) makes local changes easy.

Its tough jacket takes heavy mechanical abuse, is flame-retardant, won't fray. Cold-flow is no problem. Cutting compounds, oil, acid, water, grease won't harm it.

Plan now to add flexible Powerduct Cable to your busduct system. Be sure that you insist on the ANACONDA Trademark—your positive proof of UL approval for this use.

the right cable for the job

SHORTS THAT MAKE SENSE

PRODUCTION TOOL. Good lighting is important in any plant. With it—high quality, profitable production and fulfilled schedules are possible. Without it—spoilage, reduced efficiency, lowered quality control and poor morale may send costs skyrocketing.

ADEQUATE CIRCUITS. A lighting system is no better than the circuits that serve it. Lamp efficiency, for instance, depends on operation at rated voltage. Make sure your circuits are adequate.

PLANNED SYSTEM LAYOUT. Lack of planning never pays off. A well-designed system always costs less than a poor one. Plan for tomorrow and you cut tomorrow's costs *today*.

TOMORROW'S LIGHTING NEEDS. Many plants install lighting circuits in working areas for an ultimate of two times present lighting intensity. Play smart and follow suit. You won't be caught with your lighting down.

CURRENT RATING. No one value of current-carrying capacity (amperes) can be assigned to any one size and design of cable. Installation and method of operation must be considered.

CABLE TERMINATIONS. Moisture, like death and taxes, plays no favorites. In making cable terminations, it pays to keep this in mind—even at low voltages. There tightness against moisture is just as important as for higher ratings. Yet it's here that failures are far more frequent. Probably due to the feeling that here anything will do in the way of terminating the cable.

OVERHEAD VS. UNDERGROUND. For appearance' sake only, overhead distribution systems are often replaced by more expensive underground systems. But it's entirely possible such a change will also result in a lower annual cost. Reason: freedom from damage by trees, wind, sleet, ice, etc. Reliability is improved.

"LIVE" INSULATING OIL

Heat and electrical stress produce deterioration products which eventually sign the death warrant for insulating oil. Carbon black keeps such oil "alive." It minimizes and removes deterioration products and keeps them outside the field of the dielectric. It continually purifies and stabilizes the oil . . . keeps it clean.

Only ANACONDA Type CB* Power Cable utilizes this phenomenon. Result: greater stability and longer life. This tested paper cable may be obtained with special carbon black binder which adds resiliency, yet possesses adequate strength. A further improvement, F-3** Alloy-Lead Sheath, triples sheath life by its high resistance to slow-bending fatigue, creep, burst and abrasion.

If you're not using Type CB Power Cable, you aren't getting as much service out of your paper cables as you should. We suggest you get the full story from your nearest Anaconda Sales Office.

* CB—Carbon Black (U. S. Patents 2,102,129, 2,405,853) Reg. U. S. Pat. Off.

** F-3—Arsenic-Lead Alloy (U. S. Patents 2,300,788, 2,375,755, 2,504,600 and 2,570,501) Reg. U. S. Pat. Off.

FOR FURTHER INFORMATION about any product mentioned in the pages of this advertisement, see your Anaconda Representative . . . or write to *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

ANACONDA®

TODAY'S HEADQUARTERS FOR WIRE AND CABLE

MAKERS OF

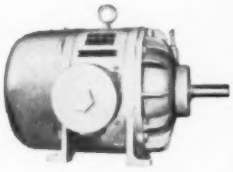
building, barn, machine tool, control and communication wire • service and overhead distribution cables, bare and weatherproof including ACSR • portable cords and cables • power and bus-drop cables • mine, bridge, aerial, underground, duct, network and submarine cables • parkway, airport and street-lighting cables • station, apparatus and vertical-riser cables • magnet wire • copper, aluminum and copperweld conductors • wire and cable accessories.

58382

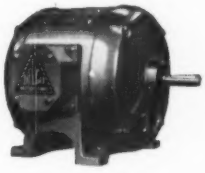
DEPENDABILITY...

that minimizes costs

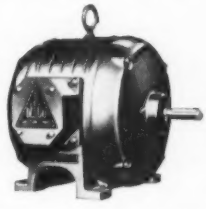
Delco Motors



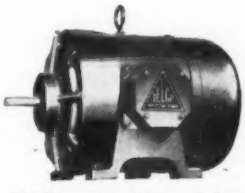
Explosion-proof motor



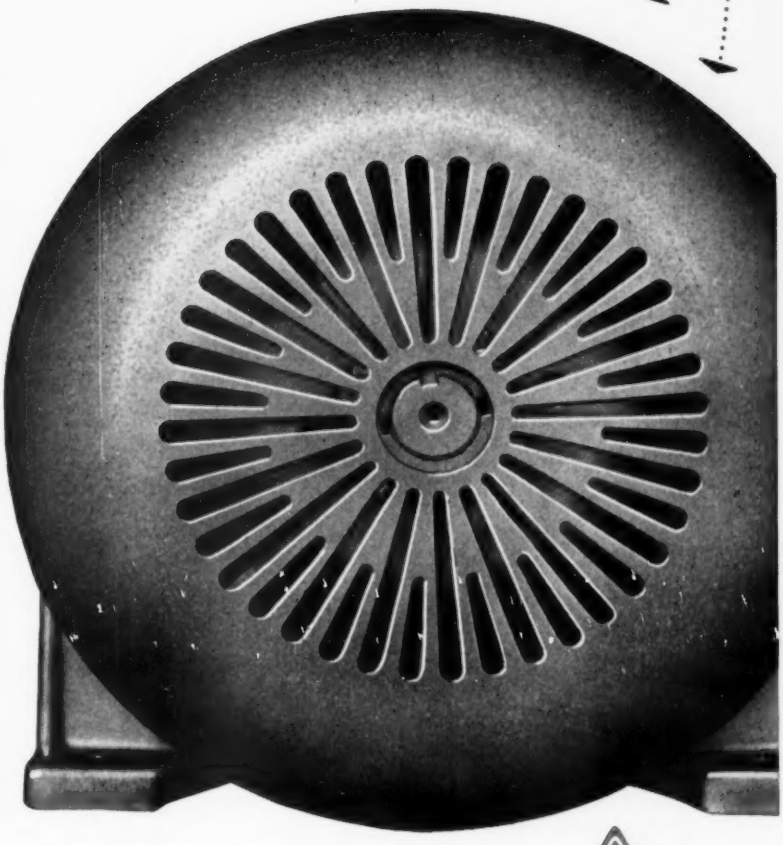
Open ball-bearing motor



Totally enclosed ball-bearing motor



Totally enclosed fan-cooled motor



With Delco integral motors on your machines you have a cost factor on which you can depend.

For Delco designs and builds with one idea in mind—to produce motors that will run dependably, under extreme conditions, for record-breaking periods of time.

Put your trust—and your motor dollars—in Delco motors . . . your nearest Delco sales office will help you with all details.

DELCO DAYTON OHIO

DELCO PRODUCTS

Division of General Motors Corporation
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Compare

See how Life-Line Starters give you a better installation on every job

The time required to install starters can make or break your job profit. That's why it pays to compare Life-Line Starter with any other motor control for easier installation—on every job.

1. *Deep-drawn, lift-off* cover exposes more of the mechanism—speeds wiring. Plenty of knock-outs, too, for easy conduit connections.

2. *Straight-through wiring* saves wire, saves time, eliminates hunting for "missing" terminals. Line terminals at the top, load terminals at the bottom—all plainly marked—all front-accessible.

3. *Pressure-type connectors* end looping of wires and provide quickly made, low-resistance connections for either solid or stranded wire.

4. *NEMA standard mounting* dimensions and wiring sequence eliminate guesswork.

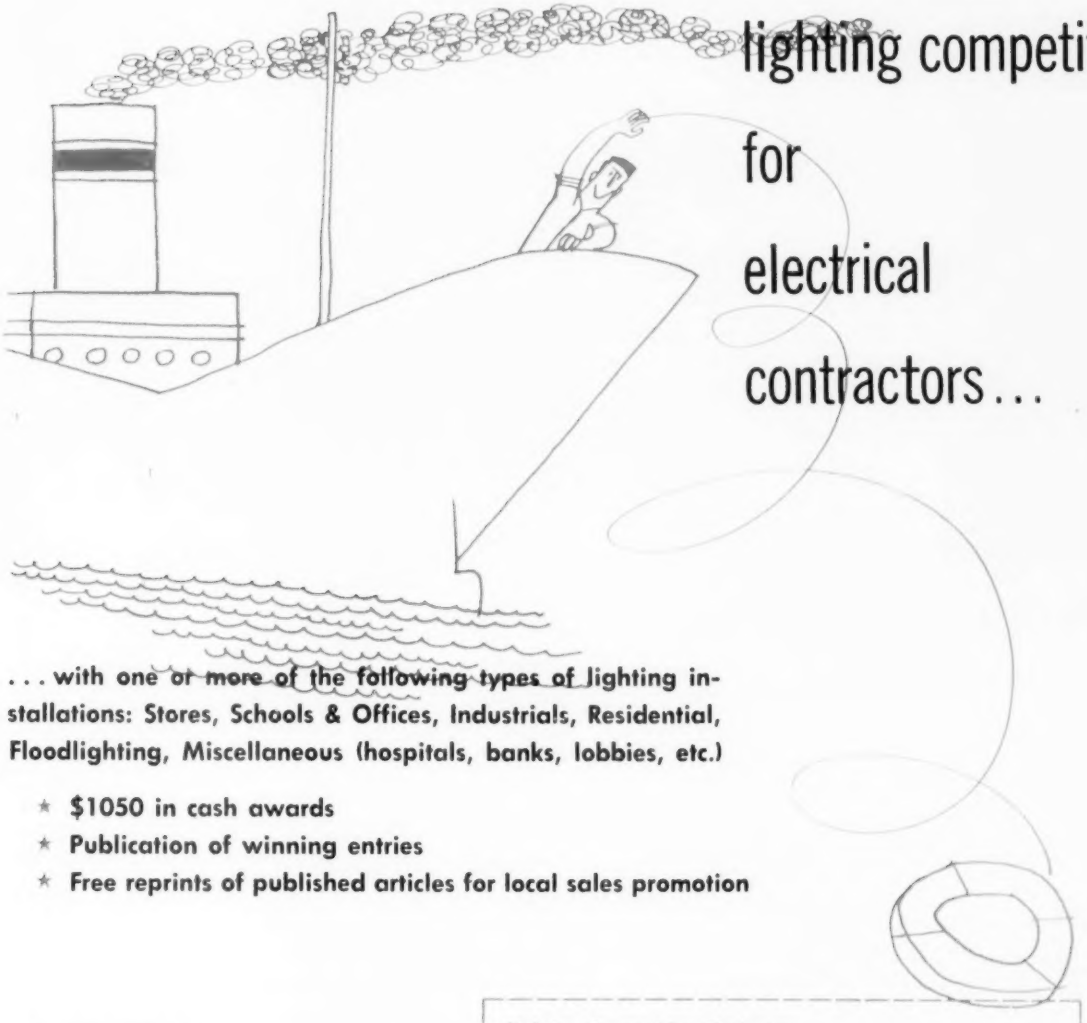
Customers get a break with Life-Line Starter, too. Simplified design and rugged construction combine dependability with exceptionally low maintenance over millions of operations.

For complete facts, see your Westinghouse Representative or write for DB 11-200, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-30158

YOU CAN BE SURE...IF IT'S Westinghouse

DON'T MISS THE BOAT...

enter the lighting competition for electrical contractors...



...with one or more of the following types of lighting installations: Stores, Schools & Offices, Industrials, Residential, Floodlighting, Miscellaneous (hospitals, banks, lobbies, etc.)

- ★ **$1050 in cash awards**
- ★ **Publication of winning entries**
- ★ **Free reprints of published articles for local sales promotion**

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A McGRAW-HILL PUBLICATION
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Lighting Competition Chairman
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USED THE MOST FROM COAST TO COAST

For many years Contractors from Coast to Coast have used Briegel All Steel Indenter Fittings. U. L. approved as concretetight and for general use, B-M Indenter Fittings are faster, easier to use and neater in appearance.

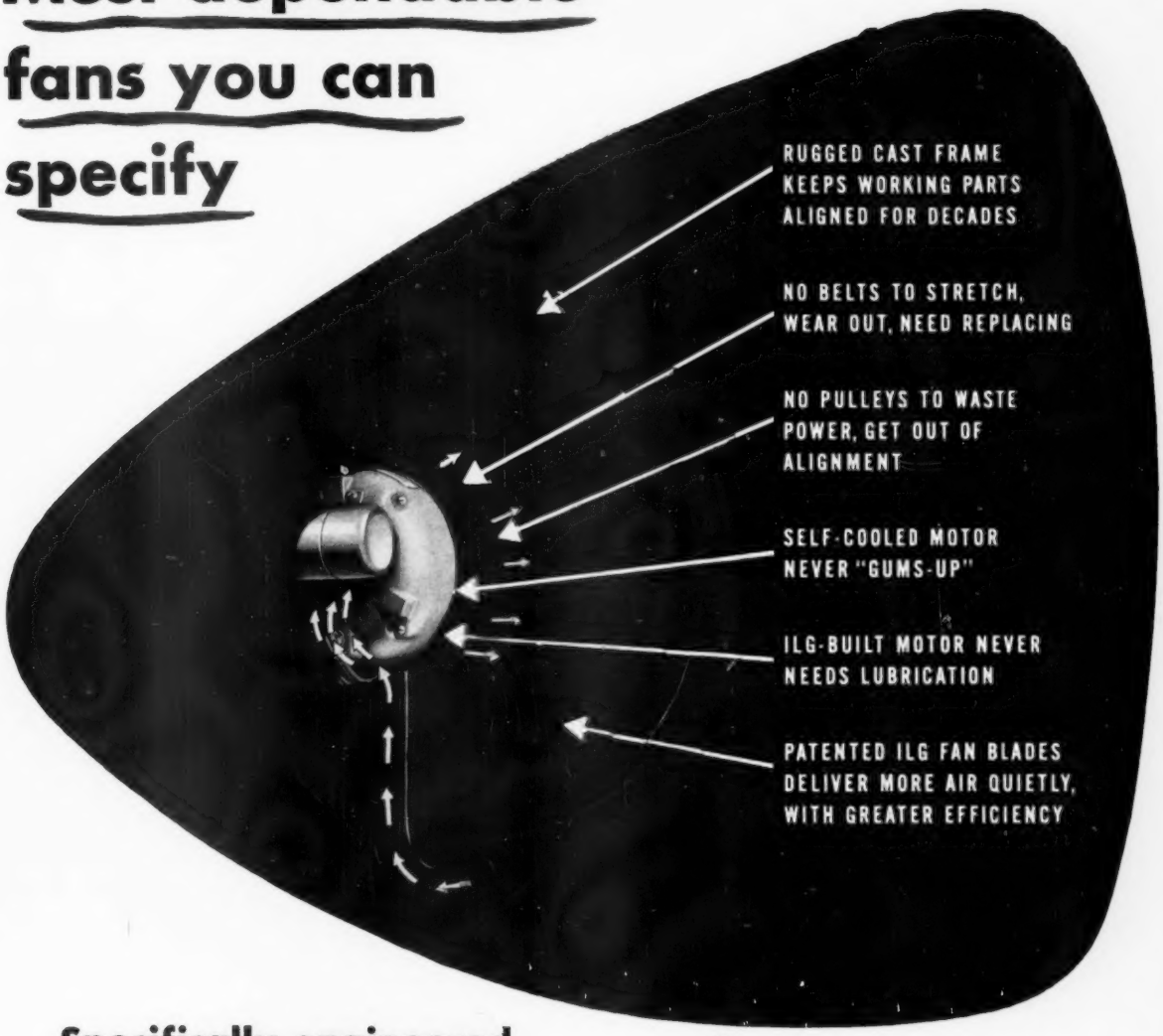
Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

BRIEGEL METHOD TOOL CO.
GALVA, • ILLINOIS

Distributed by

The M. B. Austin Co., Northbrook, Ill.; Clayton Mark & Co., Evanston, Ill.; Nikoh Tube Co., 5000 South Whipple St., Chicago, Ill.; Clifton Conduit Co., Jersey City, N. J.; The Steelduct Co., Youngstown, Ohio; Columbia Cable & Electric Corp., 235 Chestnut St., Brooklyn, N. Y.; Pittsburgh Standard Conduit Co., Pittsburgh, Penn.; Wagner Malleable Products Co., Decatur, Ill.; J. R. Richards Co., Carnegie, Penn.; Kondu Mfg. Co., Ltd., Preston, Ont.

Most dependable fans you can specify


RUGGED CAST FRAME KEEPS WORKING PARTS ALIGNED FOR DECADES
NO BELTS TO STRETCH, WEAR OUT, NEED REPLACING
NO PULLEYS TO WASTE POWER, GET OUT OF ALIGNMENT
SELF-COOLED MOTOR NEVER "GUMS-UP"
ILG-BUILT MOTOR NEVER NEEDS LUBRICATION
PATENTED ILG FAN BLADES DELIVER MORE AIR QUIETLY, WITH GREATER EFFICIENCY

Specifically engineered for exhaust-fan duty!

• You've seen exhaust fans after they have been in service for a few months . . . how the grease, dust, steam, smoke, and fumes in the air stream form deposits on the motor. If motor is an open type, these deposits "gum-up" operation, interrupt service, shorten its life. If motor is fully enclosed, deposits form a blanket of insulation—the motor "runs hot." Recognizing these facts, ILG created the now internationally famous Self-Cooled Motor. When fan is operating, clean, cool, fresh air is drawn through the vent pipe from OUTSIDE, circulated through the motor, then exhausted from front of motor. Motor stays clean, cools itself—it is not affected by deposits on the cover—no foul air reaches it to cause trouble. Result—the most dependable fan you can specify. Send coupon, or phone nearby Branch Office (consult classified directory) for latest data and prices.

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knows ventilation!

1879 North Crawford Ave., Chicago 41, Ill.

Free! Engineering data Bulletin 150 contains all essential data—sizes, capacities, dimensions, ratings. Send coupon now.

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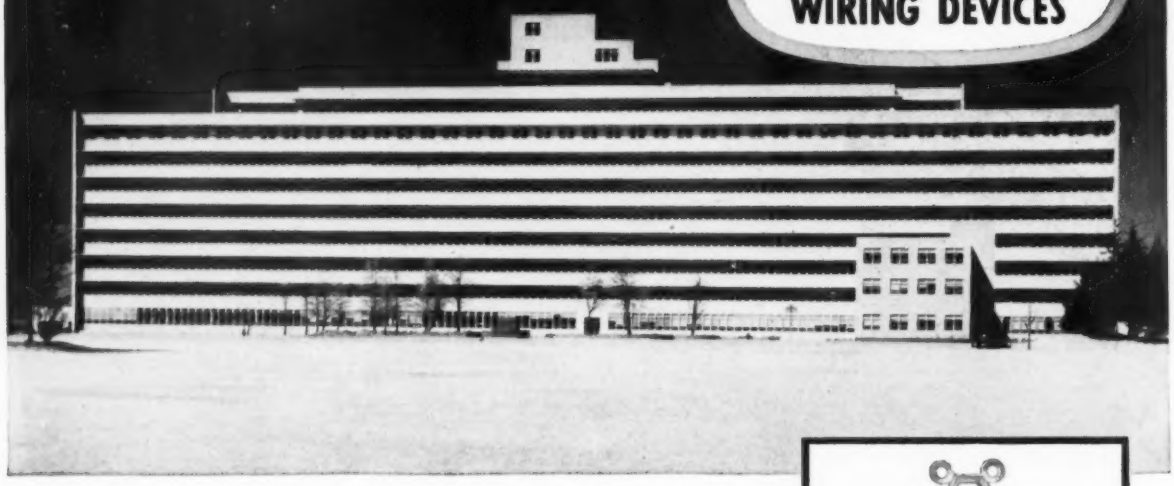
At the Seattle Veterans' Administration Hospital

THE ANSWER IS
BRYANT
WIRING DEVICES

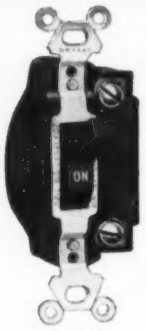


Architects—Naramore, Bain, Brady & Johanson—Seattle, Wash.
Electrical Engineer—Beverly A. Travis & Associates—Seattle, Wash.
Electrical Contractor—Agutter Electric Co.—Seattle, Wash.
General Contractor—Sound Construction Co.—Seattle, Wash.

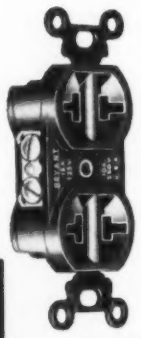
NEW 325 BED VETERANS' HOSPITAL. This ultra-modern, 8-floor hospital building is functional to the last detail—and keynoting its functional design are dependable Bryant wiring devices throughout the building.

THE ANSWER IS BRYANT QUALITY. When specifications called for once-installed, stay-installed wiring devices, the choice was Bryant. For instance, rugged 20 Ampere switches, No. 5861, meet rigid hospital standards where heavy loads are encountered. And the popular No. 4832 Bryant Duplex Outlet does yeoman duty in rooms, corridors—any place a dependable outlet is required.

MAKE YOUR CHOICE BRYANT. There's a full line of Bryant quality-made wiring devices to meet any specification. Choose from the full line for residential, commercial or industrial applications.



No. 5861



No. 4832

Specify Bryant from your Electrical Distributor

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The Bryant Electric Company

Bridgeport 2, Connecticut

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BRYANT
SUPERIOR WIRING DEVICES

J 99889

INSTALL WIREWAYS FASTER!

SQUARE D's NEW AND EXCLUSIVE *Lay-in Duct*

FASTER ASSEMBLY!
LESS NUTS AND BOLTS
FASTER WIRING!
NO MORE THREADING OR PULLING OF CONDUCTORS...JUST LAY THEM IN
FASTER HANGING!
UNIVERSAL TYPE HANGERS
FASTER GANGING!
KNOCKOUTS MATCH THOSE ON RELATED SQUARE D EQUIPMENT. NO CONDUIT BENDING

Square D's exclusive design provides hinged covers for both the duct sections and connectors. Easily removable fitting covers then provide a completely unobstructed wireway in which to lay wires.

LAY-IN DUCT is available in 2½" x 2½", 4" x 4", and 6" x 6" sizes, in standard lengths of 1, 2, and 5 feet. There is a complete line of fittings, all with the "lay-in" design feature.

• • •

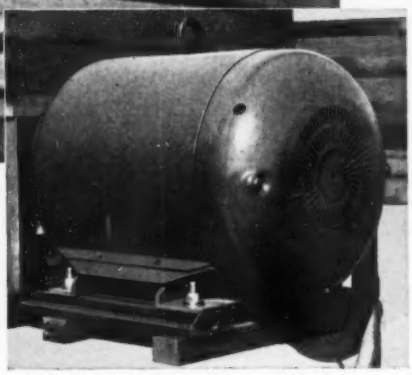
Write for the complete story of **LAY-IN DUCT**—how it gives you a better wireway system, easier, faster and at less cost. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

1903 • **50** YEARS OF DESIGN LEADERSHIP • 1953

8 cell cooling tower driven by 8 Wagner Multi-speed Motors.



Here's a job for *Rugged* motors

This 8 cell Marley Cooling Tower, at Pueblo, Colorado, provides a steady supply of 6600 gallons of cooling water per minute for a steam power plant. There are 8 fans with blades 22 feet in diameter that are driven, through gear reducers, by 8 Wagner two-speed, totally-enclosed fan-cooled motors. These 440 volt motors are each rated 75/19 hp.

Cooling towers need motors with plenty of stamina. They must operate without attention, day in and day out, completely exposed to all kinds of weather.

Wagner totally-enclosed fan-cooled motors are built to operate under severe conditions. They are available in steel or cast iron frames, in standard or explosion-proof types, single-speed or multi-speed, single phase, 2 phase or 3 phase, in ratings to 250 hp.

For your requirements, there is a Wagner Motor to fit every need—a complete line for all current specifications, with a wide variety of enclosure types and mountings. Bulletin MU-185 gives full information. Do you have a copy?

Your nearby Wagner engineer will be glad to help you select the *right* motors for your next application. Call the nearest of our 32 branch offices, or write us.

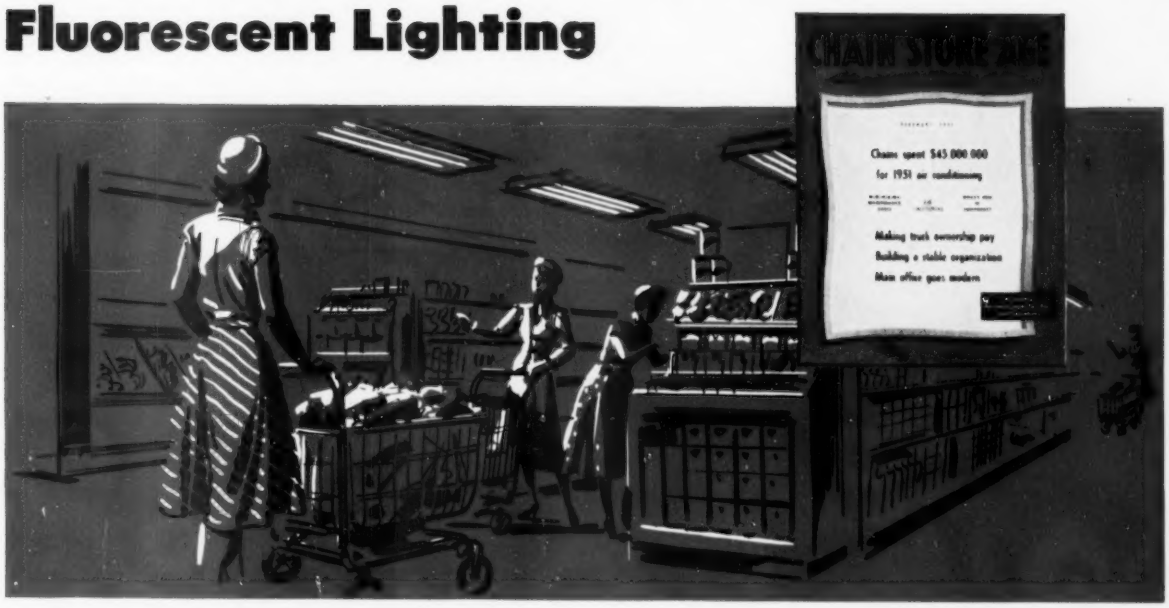
WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

M53-18

Chain Store Age Recommends CERTIFIED BALLASTS for Fluorescent Lighting



CHAIN STORE AGE, in advising chain store operators on their selection of fluorescent lighting equipment, said:

"The ballast is the heart of a fixture. The surest way to choose a ballast is to look for the Certified shield . . . it is the only assurance of long lamp life. Inferior ballasts delivering wrong wattages result in low light output."

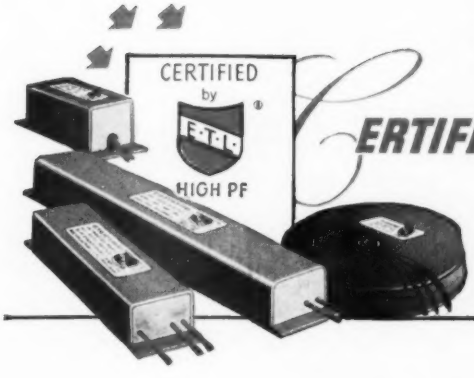
Experience has proved that CERTIFIED BALLASTS assure:

Full Lamp Life **Rated Light Output** **Maximum Ballast Life**

CERTIFIED BALLASTS are made to precise specifications, then tested by Electrical Testing Laboratories, Inc., which certifies they conform to these high standards.

Write for complete information on the types of CERTIFIED BALLASTS available from each participating manufacturer.

Participation in the CERTIFIED BALLAST program is open to any manufacturer who complies with the requirements of CERTIFIED BALLAST MANUFACTURERS.



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting

2116 KEITH BLDG., CLEVELAND 15, OHIO

EASY

TO BEND . . . flexible and strong

TO CUT on the job

TO HANDLE . . . free stripping

COLUMBIA

A.B.C. Armored Cable

The Safe, Economical, Grounded, Steel Covered Wiring System

Flexible, strong and easy-to-handle, Columbia A.B.C. Armored Cable is galvanized to resist corrosion. Rubber covered conductors mean safe, dependable wiring. And, Columbia gives you the kind of service that keeps your jobs "on-schedule."

Approved by Underwriters Laboratories

Columbia CABLE & ELECTRIC CORP.

Serving the Electrical Wholesaler Since 1912

255 Chestnut St. **Brooklyn 8, N. Y.**

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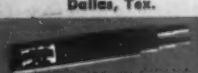
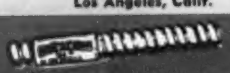


NON-METALLIC SHEATHED CABLE



FLEXIBLE STEEL CONDUIT

E. M. T.

A.B.C. ARMORED CABLE

Washington Report

Business boomed along at a high level over the first four months of this year, Commerce Dept. reported, as corporate investment and consumer buying stayed high. Rate of inventory pileup, which businessmen and economists worried about early in the year, dropped to about one-fifth the rate of the last half of 1952. Unfilled durable goods orders at the end of February totaled about $70-billion, which backlog represents an equivalent of about six months at current output rate.

Cutbacks in appropriations will affect all Federal agencies and many U. S. projects and services, if the new GOP Administration gets its way. Policy is to have "less government", as was promised in election campaign. A review of revised budget requests indicates there will be less statistics gathering, fewer special favors for farmers, less government aid for flood control, airports, ships and public power projects. Large reductions of personnel are being planned in all agencies, both in and out of Washington, and will be effected by July 1 (beginning of the new fiscal year)—if Congress goes along. It's all a part of the Administration's program to reduce cost of Government, and to balance the budget.

Expenditures for new building construction are continuing at about 7% ahead of 1952, with private funds accounting for a major part of the overall gain. Private expenditure gains in March this year over 1952 were: commercial –44%; warehouses, offices and loft buildings –38.9%; stores, restaurants, garages –49.2%; religious –14.%; educational –14.8%; and social recreational –18.5%. Industrial was down 5.2%.

New public housing starts are forbidden after June 20 under a House bill passed and sent to the Senate on April 22nd. But the same appropriations bill had a provision dropped which would have liquidated FNMA, recommended by the House Appropriations Committee. The new Administration had already approved 35,000 public housing starts for the new fiscal year.

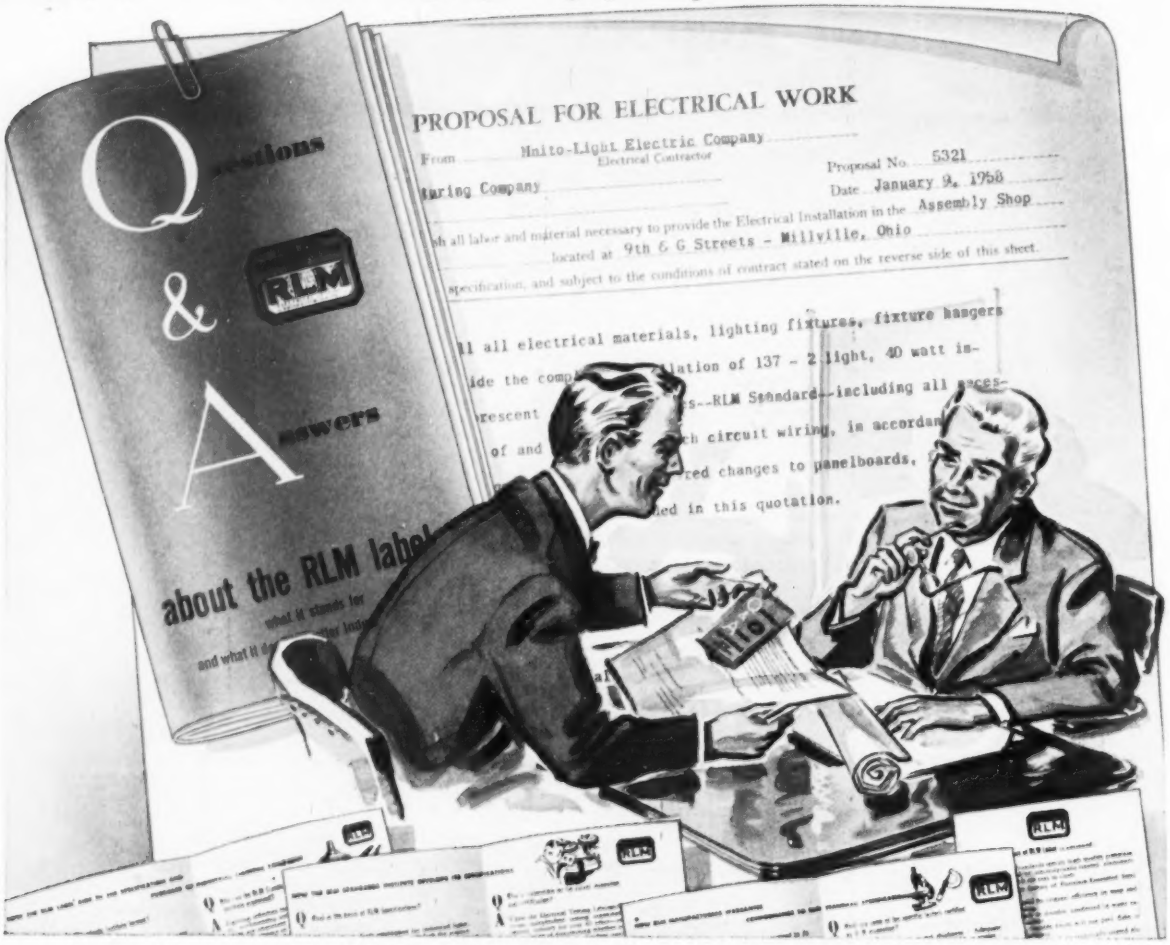
Certificates of necessity involving accelerated tax amortization in the amount of nearly $26-billion had been approved by ODM up to April 8 this year, covering 16,419 new or expanded facilities. Such approvals are still being made at the rate of over 100 weekly, to expand private industry's productive capacity to meet mobilization goals. While no "reversal" of this policy has been made, the Defense Department is decreasing the number of plants producing weapons and other munitions in order to reduce unit costs by eliminating production in the less efficient, high cost plants.

The nation's tax laws are in for a complete overhaul under plans of the tax-writing House Ways and Means Committee. Target date is mid-1954. The House version of the new tax legislation will be proposed early next year, after which the Senate will receive it for debate. Subjects which will soon receive public hearings include: universal sales tax; income tax ceiling; elimination of excise taxes; excess profits taxes; tax simplification, etc.

Business and personal income tax reductions scheduled for next year are unlikely, unless there is a sharp reduction in Federal spending. Present cutbacks in budget appropriations for next year are in an effort to reduce an estimated $10-billion deficit. Moreover, tax income this year is falling short of Truman's estimated $68.7-billion by some $2-billion.

Peace in Korea will not greatly affect the current rate of military spending, according to Administration spokesmen. Present annual rate is about $54-billion. Cutbacks are not expected to exceed $4-$6-billion, and would be gradual, not abrupt.

Every question concerning lighting quality is answered...



...when this new RLM QUESTIONS and ANSWERS BOOKLET is attached to the industrial lighting bid!

Industrial lighting bids submitted by progressive contractors have this new, pocket-size RLM Questions and Answers booklet attached to them. This is a valuable service to the buyer, because the booklet explains the importance of quality in lighting equipment and the meaning of the RLM Label on the units recommended by the bid. In eight pages, the booklet answers the buyer's most frequently-asked questions in regard to increased lighting efficiency, improved performance and longer life. It gives him sound, dollars-and-cents reasons why it pays in the long run to put out the slightly-higher price for lighting equipment which conforms to RLM Quality Standards.

To the seller, too, this booklet performs a valuable service. By promoting a keener understanding of the merits of quality lighting equipment, it helps build a sound business, based on good will and satisfied customers.

Whether you buy, sell or specify industrial lighting equipment, we'd like to send you a copy of the new RLM QUESTIONS and ANSWERS BOOKLET. Address request to: RLM STANDARDS INSTITUTE, Suite 819, 326 West Madison Street, Chicago 6, Illinois.

Copies are available for distribution in quantity, through the 28 leading manufacturers, who are members of the RLM Standards Institute. A list giving the names and addresses of these lighting equipment manufacturers will be sent to you upon request.

R192

MAY . . . . at a Glance

NISA to New York

The 1953 convention committee of the National Industrial Service Association is preparing for a record turnout. Slated for May 24-28 in New York City, the convention offers a brisk business program, a trade show and a well planned social schedule. It is also an opportunity to visit some of the best managed motor shops in the nation. For a preview, editors Scott and McPartland with the help of Walter J. Prise of the convention committee, visited a number of Metropolitan Area shops seeking out interesting shop methods. Thanks to the splendid cooperation of all concerned, the proceeds of their efforts appear in "Motor Shop Ideas" on page 87.

Airport Cables

Lives can depend upon the reliability of an airport lighting installation. And reliability depends on both the quality of the materials and the quality of workmanship and skill with which the system is installed. Considering the special circumstances of airport electrical installations, electrical contractors must be alert to the kinds and sources of danger to the system. R. C. Graham of Rome Cable appraises the frequency of trouble due to various causes and points out the methods for preventing them in "Minimizing Failures in Airport Lighting Cable" on page 110.

Elevator Care

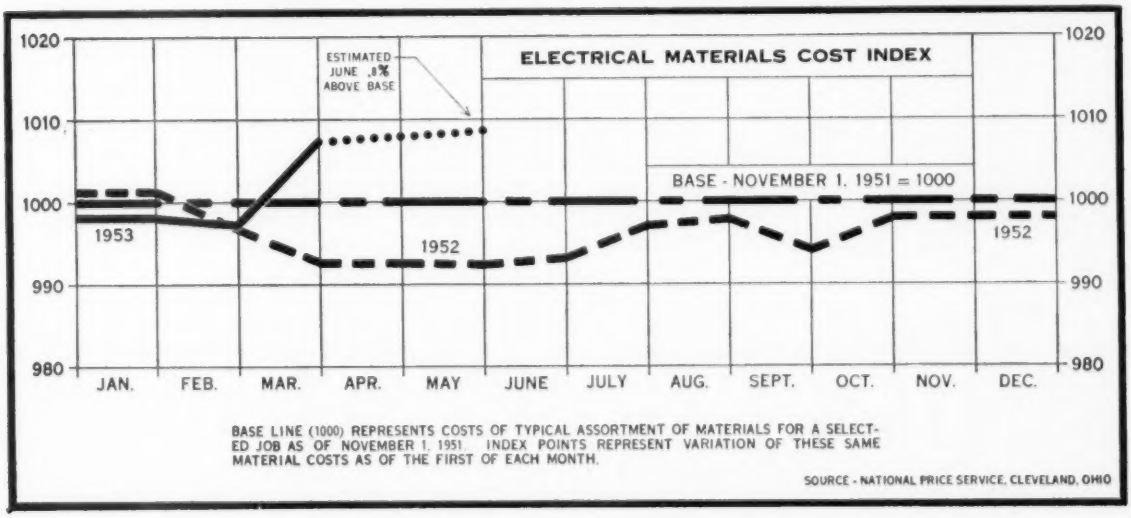
An integrated program of inspection and service is the key to successful elevator maintenance, according to Walter J. Prise, Chief Engineer of The Maintenance Company of New York. He talks from practical experience since his company is both one of the largest and one of the most successful shops handling elevator maintenance. He has outlined the important steps of an integrated program of elevator maintenance for us in his article "Practical Elevator Maintenance" on page 120. The illustrations are on-the-job photos of elevator maintenance operations.

Heat Pumps

Few devices are as intriguing to the engineering mind as the heat pump. Only a short few years ago it was an engineering novelty. Today a substantial number are in regular operation in commercial buildings and homes, cooling in summer and heating in winter from the same equipment powered by electric energy. I. B. Faigen and D. W. Hoppock of the Carrier Corp. have prepared a roundup of heat pump operating fundamentals written especially for electrical contractors in "What the Electrical Contractor Should Know About the Heat Pump" on page 114.

Highway Lighting

Paralleling the giant task of modernizing our highways is the equally important job of lighting them. As an area for electrical development, highway lighting plans are still far short of covering the most urgent requirements. But several installations of recent years may encourage public pressure to bring night-time safety to at least the most travelled major highways. Eden's Expressway skirting Chicago's North Shore suburbs is a fine example of modern highway illumination. And the work of Monroe Electric Co. and Contracting and Material Co. in installing the 14-mile project is a study in modern job mechanization. Middle West Editor August Eckel covers the story for us in "Mechanization Paces Superhighway Lighting Installation" on page 92.



BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.

SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO

Industrial
R&S LIGHTING FIXTURES

...3 Complete Lines meet every safety lighting need!

EXPLOSION PROOF

CLASS I, GROUPS C & D

For greater safety in hazardous locations wherever flammable materials are made or used. A complete line is available in pendent, ceiling, bracket and hand types — from 100 Watts through 500 Watt sizes. Standard conduit bases permit interchangeability of reflector globe assemblies.

WRITE FOR CATALOG No. H-47-4

DUST-TIGHT

CLASS II, GROUPS E, F & G AND CLASS III

For hazardous locations where flammable or explosive dusts are present. Streamlined design prevents dangerous accumulation of dust particles. Two exclusive design features facilitate easy cleaning and relamping. Standard pendent and junction box bases accommodate any style of fixture — globe — assembly interchangeably in either 100 Watt or 200 Watt sizes.

WRITE FOR DATA SHEET No. 7151-4

VAPORTIGHT

For efficient illumination and maximum indoor and outdoor protection against non-inflammable gases, vapors, dusts and moisture. A complete line available in pendent, ceiling and bracket types from 15 Watts through 500 Watt sizes. Bases remain vaportight when globes are removed or broken in service.

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R&S also makes a complete line of marine fixtures and fittings

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PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902

ELECTRICAL CONSTRUCTION AND MAINTENANCE

52nd Year—MAY • 1953

More Modernization

PLANS FOR INDUSTRIAL EXPANSION are showing a decided swing toward modernizing existing facilities. The trend is clearly evident in the current annual survey of plans for capital expenditure made by the McGraw-Hill Department of Economics. It foretells changes of much significance to the electrical industry.

NEW CAPITAL EXPENDITURES planned include a broad range of facilities. Land, buildings and machinery take a great many services including wiring for light, power and communication, motors, controls and a growing complex of electrical apparatus. Thus capital expenditure plans encompass a large and important area of the electrical market.

WHEN PLANS SHOW A SWING to modernizing existing plants a considerably larger share of the available dollar is destined for electrical facilities. The present trend should be optimistic market-wise for electrical contractors. And such modernization plans are quite rightly recognized as one of the great market opportunities of the industry in these times.

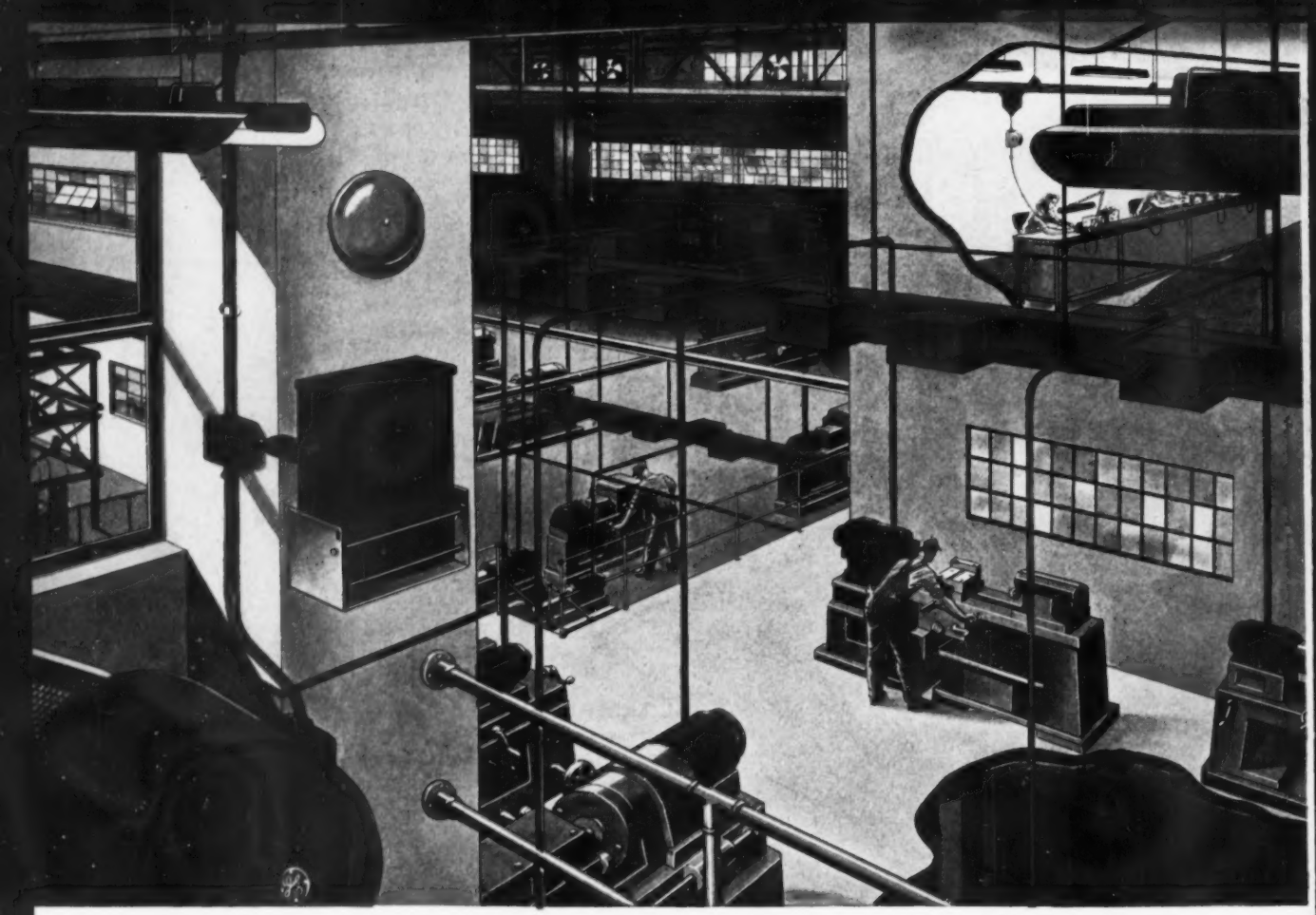
IN BRAND NEW BUILDINGS, planned by top flight consulting engineers, we have enjoyed advanced electrical system design. In new brick and mortar we expect to find modern lighting and modern power distribution. And owners are usually willing to plan boldly and confidently. But do we have the resourcefulness to bring the same kind of planning into the electrical facilities involved in industrial modernization?

THERE IS NO EASY ANSWER. Modernizing existing plants inherently involves the substantial reuse, where practical, of the existing facilities. And where existing facilities are so technical in function and so little understood by management as electrical work is, bold plans and advanced electrical design, however well conceived, are in for a rough time.

INDUSTRIAL ELECTRICAL SYSTEMS are strictly functional. The advanced electrical designs in great new plants are "advanced" because they do their job better, more economically, more effectively than older methods. Modern high intensity lighting on an assembly line or a flexible power distribution layout are not whims of fancy. They are the result of hard industrial experience and realistic engineering decisions. Their functions are entirely independent of the date on the cornerstone of the building.

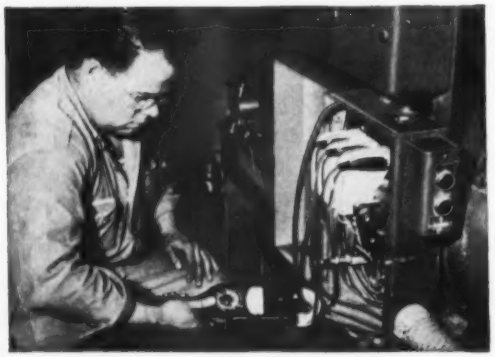
IF THE ELECTRICAL INDUSTRY will accept its obvious responsibility there need be no double standard of electrical performance–one for new buildings, another for old. The industrial electrical job should provide the same order of performance and utility whether the structure is new or old. Modern materials, methods and services are fully competent to handle the task. But it is going to take one of the biggest educational and sales jobs of all time.

Wm. T. Stuart



RADIAL LOAD CENTERS, TRANSFORMERS, CAPACITORS, AND BUS DUCT SYSTEMS contribute heavily toward lowered production costs for your industrial clients — a fact that grows in its importance to them each day. To help you plan efficient power distribution systems for them, feel free to call on the services of a Graybar Representative at any time.

How modern power distribution systems cut costs



ELECTRICAL CAPACITY DOUBLED without new transformers or wiring when a G-E capacitor was installed here — savings in power costs paid for installation in 3 years. G-E capacitors and other popular G-E power distribution equipment is distributed nationally by Graybar.

Here are figures your customers will find hard to ignore in their drive toward lower production costs:

- **up to 34% more capacity from existing systems**
- **up to 18.5% less shutdown time**
- **up to 50% savings on power costs**
- **up to 150% annual return on your investment**

Powerful statements, to be sure, but still *facts* that can be backed up with actual case-history proof by your local Graybar Representative.

If your customers face the problem of designing a new power distribution system – or of forestalling major rewiring through increased efficiency of an existing system – then *now* is the time to call Graybar.

You know that it's just as costly to plan for, install and service inferior, misfit equipment as it is to do the same with quality items custom-fitted to specific needs. Let Graybar Power Specialists help you *prove it to them.*

As distributor of over 100,000 different electrical items made by 200 leading manufacturers, you can always be sure of carefully-considered, impartial recommendations. It's the common-sense result of ordering power needs – as well as equipment for lighting, wiring, ventilating, and communication – *via a single source . . . a single responsibility. Graybar Electric Co., Inc. Executive Offices: Graybar Building, 420 Lexington Avenue, New York 17, N. Y.* 341-45

Call Graybar first for...

GraybaR Everything Electrical

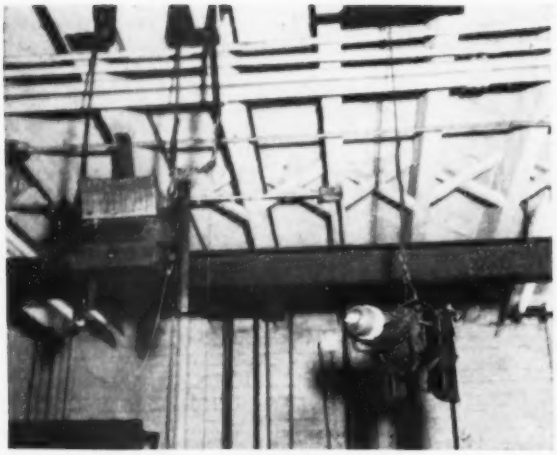
IN OVER 100 PRINCIPAL CITIES

MOTOR SHOP IDEAS . . . you will see in and around metropolitan New York; NISA's Convention City for 1953

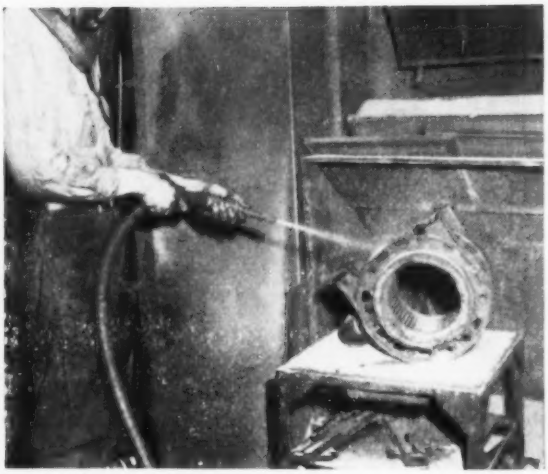
Radio-telephones for repair trucks, commutator bar rolling mills, sand and grits blasting equipment, organization hints, coil compressors, armature banding apparatus, mobile work benches, test boards, multi-reel wire feeders, copper sleeves for armature-supporting casters, gas-jet coil roasters, soldering rigs, cam-operated stripping tongs, counterweighted growlers, hydraulic presses and paint tanks are among the modern methods and shop techniques NISA delegates will find in the many motor shops in the metropolitan New York area.

TROUBLE-SHOOTERS servicing motors and major appliances in New York City's suburbs for the S. J. O'Brien Sales Corporation can keep in touch with their main office through the medium of a 2-way radio-telephone system. Transmitters and receivers with French-type phones are mounted in the service trucks and high-quality reception is possible within a radius of 30 miles with these crystal-controlled FM sets.

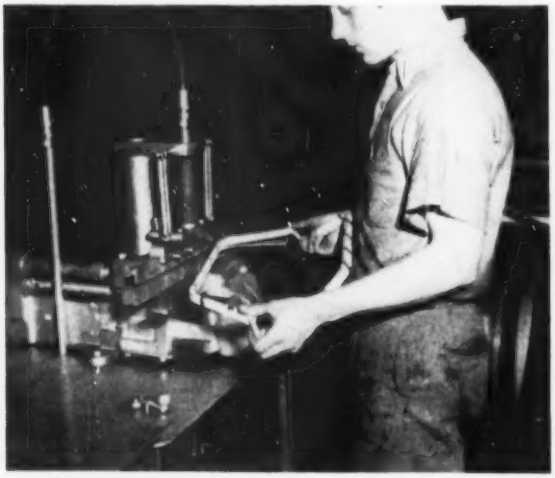
The central transmitting and receiving station is operated by the N. Y. Telephone Company and, since calls may be originated by either the driver of the truck or the dispatch man at the home office, close contact is maintained to expedite the handling of emergency calls, the delivery of replacement parts or similar services. Efficiency is further improved through the use of standard radio transmitting procedures and the adoption of a special requisition book that eliminates the possibility of error.



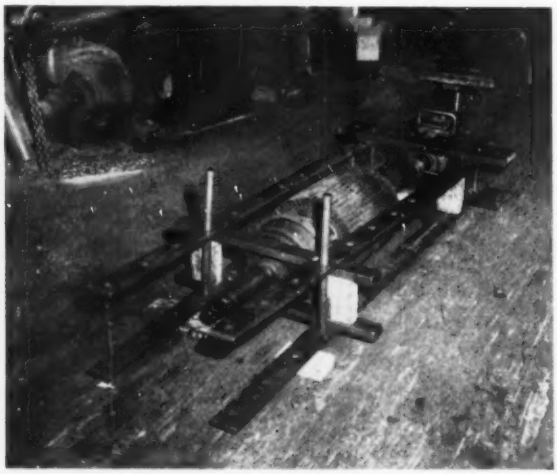
GROWLING OPERATIONS have been reduced to a minimum in time and effort through the use of suspension mounted growlers at the motor shop of The Maintenance Company, Bill Wheeler, president. Here, two growlers are hung from the ceiling on counterweighted lengths of rope. As shown in the above photo, one growler, the larger one, is supported by two ropes; the other is hung from a single rope. In both cases, the ropes are carried over pulleys mounted between ceiling beams, run back to the wall, over a second pulley assembly and down to the counterweights. A single two-conductor cable is arranged on another pulley-and-counterweight rig, between the two growlers, to energize one or the other of the growlers as required. A pullstring is attached to each growler and to the power cable for pulling the equipment down to the work level. When work is complete, the equipment is readily pushed up and out of the way of other work.



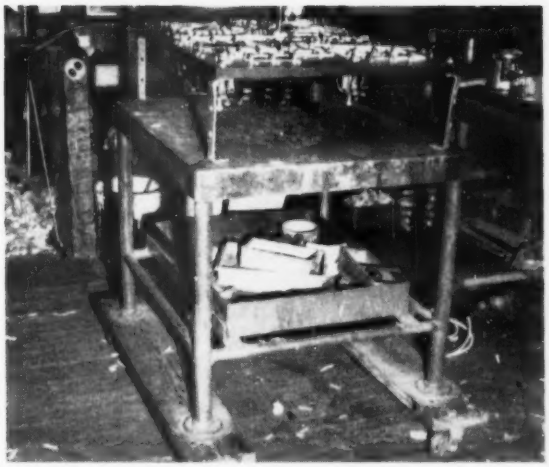
GRITS BLASTING has been found a versatile and highly effective cleaning method at the Consolidated Electric Motor shop, operated by Sam and Joe Heller. In this method, dust-free corn cob grits are fed from a portable tank and driven by high-pressure air through a hose which concentrates the grits blast in a fine stream. The air acts only as a carrier and is derived from the shop's regular 5 hp air compressor. This grits blasting unit, commercially available, is used for cleaning all types of motors, for removing paint, oil, grease and other dirt. Offering cleaning by blast and absorption, the method is completely safe due to the non-conductive characteristic of the grits. Motors can be cleaned with a minimum of dismantling (large synchronous machines have been cleaned intact) and electrical tests can be made on machines immediately after cleaning. Equipment can be cleaned indoors or out; a canvas hood is often used to confine the flying grits.



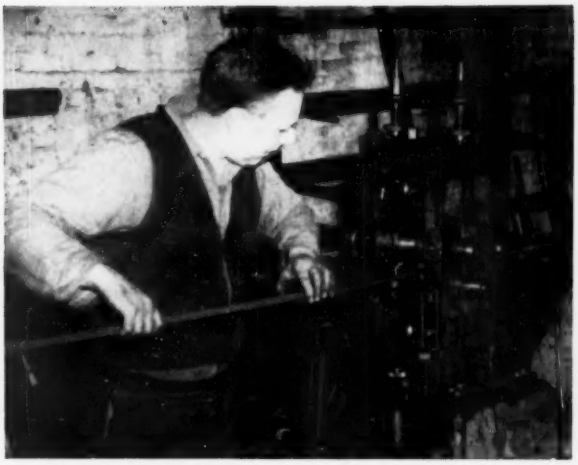
COIL COMPRESSION is one of the most important factors in the construction of form wound coils, a specialty and large volume item at Karl Meyertons' Premier Electric and Engineering Company. Here, a typical form wound coil, for a 4150-volt 4-pole 400-hp motor which was redesigned from a lower voltage, has just been removed from the compression unit. This cold coil compressor is hydraulic powered, with air pressure used to operate the hydraulic pressure. Exerting pressure of 14,000 pounds on the sides and tops of coils, this unit assures the proper compressed form of coil turns. It is extremely important that all hi-tension form wound coils be tightly compressed to eliminate as much as possible any space between coil turns, thereby reducing the possibility of air ionization and arc-over between turns during operation.



A SPECIAL RIG for removing or replacing commutators on large armatures has speeded-up and simplified an otherwise difficult operation at Dooley Electric's motor shop, operated by Paul Dooley. Ordinarily, a commutator is removed from a shaft or replaced on a shaft in a large vertical press. Inasmuch as it was found difficult and time-consuming to lift large armatures onto this press, the rig shown above was developed. It consists of a standard 80-ton hydraulic pipe bender used in conjunction with specially fabricated steel framing members. As shown, the rig is being used to press a commutator on a large armature. The bending press, at the back, is rigidly secured to the framing. Two transverse steel pieces are held against the commutator by a set of bars. As the press applies force, the commutator is forced back on the shaft.



MOBILE WORK TABLE is one of a number of such specially constructed stands which facilitate handling the large volume of industrial control work at Meyer Friedkin's Electric Enterprise shop. The table is of welded construction with legs and braces of pipe and a flat steel top. A large tray for holding supplies and accessories is mounted on angle iron runners between the pipe braces, under the top. As shown, the complete table assembly is mounted on 2 in. by 8 in. board lengths, with each table leg secured to the board by screwed-down pipe flanges and casters under the boards. These tables are particularly useful in this shop which specializes in the custom design and construction of motor control boards, contactor assemblies and relay panels. Above, a typical control board is supported on the table by flat steel members bolted to the four corners of the board. The technician has ready access to the firmly supported board and rotates the table as required.



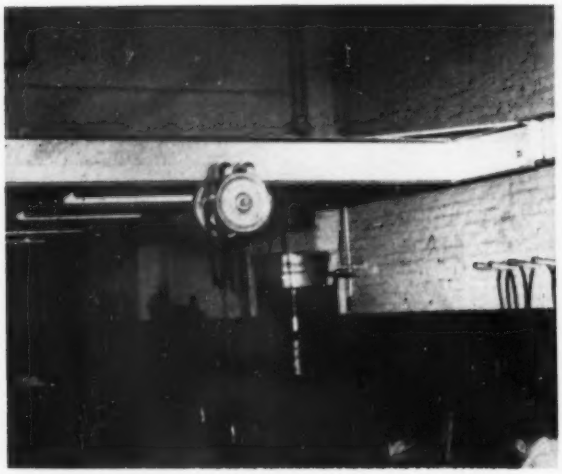
COMMUTATOR BARS, bevelled and dimensioned for non-standard or emergency jobs, are made by the Wood-Warner Engineering Company, New York City, with the aid of a shop-made rolling mill. Since this company also carries a comprehensive stock of spare armatures and standard bars, it renders a valuable subcontract service to other companies engaged in elevator maintenance.

Depth, thickness, bevel of bars and pressure of rollers is approximately adjusted by jack screws located above and below the bedplate of the mill, then adjusted exactly by calibrated adjustment wheels, graduated in 100th of an inch, mounted on the shafts of the small micro-leveling drums.

The unit is powered by a 4-hp motor running at 1200-rpm. This speed is reduced, through a gear train, to a roller speed of 4-rpm, resulting in a horizontal bar speed of 3 inches per minute. This reduction insures accurate, guaranteed results.

SOLDERING SPEED, ease and efficiency have been effected through the use of a special method at Fred Schneider's Electric Motor Shop. The equipment used includes: a 110/12 volt transformer, two secondary cables to handle the heavy current, a carbon electrode holder and a terminal for contacting the work. One of the many applications for this soldering technique is shown above where leads are being sweated-in on an 88 bar commutator. Here, the work-terminal is strapped to the commutator adjacent to the bar-slots being soldered; the carbon electrode is held close to the slot; and the solder is fed into the carbon arc. Ordinary solder is used, and a dab of soldering flux is placed in each slot to assure a clean joint. The advantages of this method are instant heat and a higher constant heat level, reducing time and effort.

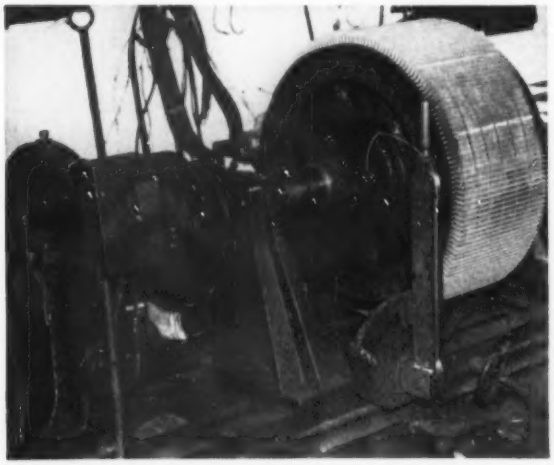
ROASTING INSULATION from damaged stator coils prior to stripping is accomplished in the shop of the L & P Electric Company, Brooklyn, N. Y., through the use of a multi-jet gas burner mounted in the center of a circular rotating steel-plate stripping bench. A gas supply line rises through the center of the pedestal and several sizes of burner heads are available; their selection being dictated by the internal diameter of the stator. These heads consist of metal cylinders, drilled with many holes through which the flames shoot. The top of the cylinder is capped so as to force the flames sideways, and the bottom of the cylinder is equipped with a collar that snugly fits around the gas line. Low gas consumption and short heating periods result from the close proximity of the flames and stator coils.



REPAIR WORK is speeded in the shop of the Davidson Electric Company, Brooklyn, N. Y., with the aid of modern equipment, high-capacity overhead cranes, electric unit heaters, infra-red baking facilities, loading platforms, angle-mounted directional fluorescent lighting and a modern, comprehensively-equipped engineering-drafting room. Since this room is on the second story level of the shop and partially overhangs the repair and shipping areas, direct visual and verbal supervision of operations can be maintained from this point by sliding back a large plate-glass window in the office wall. When quiet is desired in the acoustical-tiled air-conditioned office, the window may be easily closed.

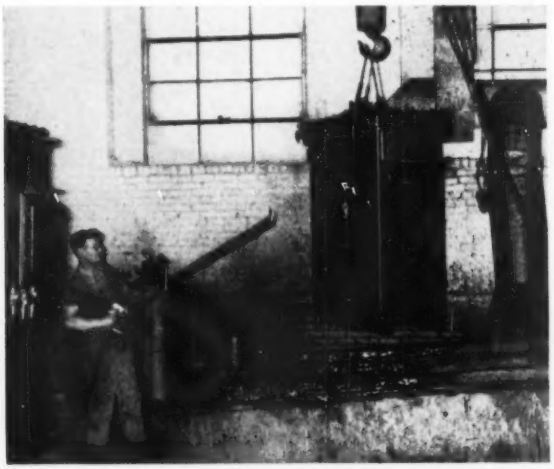
In the shop, equipment for dipping, stripping, baking and testing of motors is located along the walls, leaving the center free for assembly and heavy work. Machine work and coil winding is segregated in separate sections.

SELECTOR KNIFE SWITCH is one of the many shop-constructed components for a fool-proof motor test board designed and now being installed under the supervision of Joe Beltrandi, above, shop foreman at Ben Hasnas' Empire Electric motor shop. On the finished board, this switch will be used for selecting the proper ratio of current transformation to feed the ammeter and wattmeter current coil, depending upon the carrying capacity of the particular winding under test. Another of the engineered components of the new test board is a three-position rotating 2-pole knife switch which will be used for switching each phase winding of a 3-phase motor into the meter circuit with absolute protection of the meter movements against starting currents. The new test board, its design representing years of motor testing experience, will accommodate the widest possible range of motor tests with the minimum of switching steps and the maximum of safety.

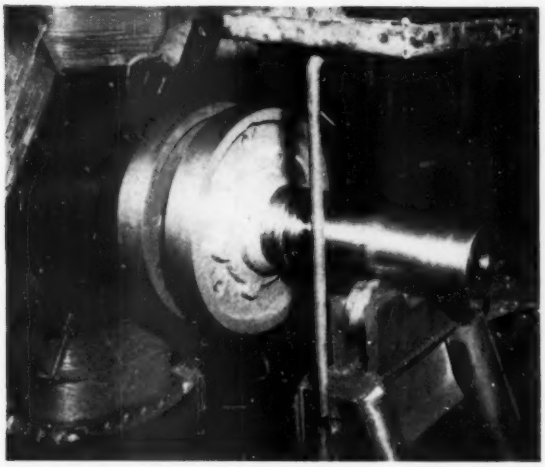


LARGE ARMATURES up to 4 feet in diameter, are banded by the A C Motor Service Company, Jersey City, N. J., by an assembly constructed from an elevator worm-gear unit, a base consisting of two 8-inch I-beams bolted to the floor parallel to each other, two sliding pillow blocks to support the armature being banded, a vertical pulley arm, foot pedal control and two motors; one 3-horsepower, the other 5. Either motor may be used to turn the worm shaft, thereby providing a choice of rotating speeds and torques.

When armatures are being banded, the banding wire is carried up the pulley arm to a 3-inch sheave just below a guiding handle which can be moved from side to side as the armature slowly revolves. Control of the wire and gear speed is accurate, and the completed banding neat and secure.

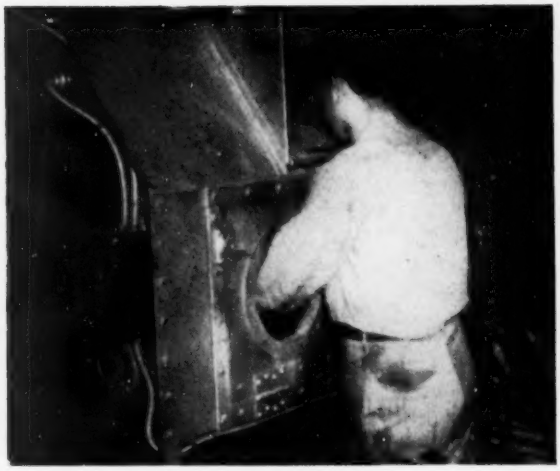


FLOW PAINTING is used in the transformer repair section of the Belyea Company, Jersey City, N. J., to apply coatings of bithulithic compound to tanks subjected to severe moisture conditions. The bituminous base paint, which would normally flow sluggishly and clog the nozzle of a spray gun, is applied by a large-diameter hose. By this flow method, the tank is covered almost as thoroughly as would be the case in an immersion tank, yet a far smaller reservoir of paint is required and the expense of a large recessed tank is eliminated. As pictured, the transformer case is suspended for the hosing operation and, since it remains suspended over the large drip pan for some time after the painting, the residual paint is salvaged in a sump for re-use. This method is fast, economical, thorough and efficient.



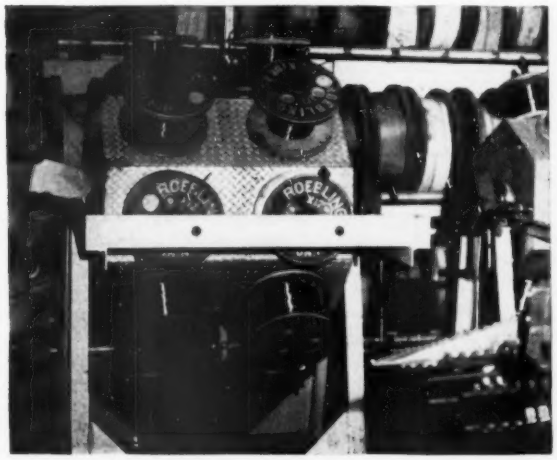
ANOTHER USEFUL IDEA comes from the shop of J. L. Hemphill in North Bergen, N. J., where steel casters, used to support heavy rotating assemblies, are faced with copper sleeves or bands to prevent the hard steel casters from scoring or otherwise marring the finished surface of the rotating shaft. Since the copper is softer than the steel shafts being supported, the shaft is properly cushioned, remains unmarred and it becomes unnecessary to refinish shafts after testing operations have been completed.

To prevent the copper facings from squashing and loosening on the steel casters, they are secured by brass screws in drilled and tapped holes. Casters are mounted in pairs, on stands formed from pipe sections welded as A-frames. Small parts and tools are conveniently supported by a tray attached to the top of a spindle which is held vertical by a steel sleeve welded to the side of the A-frames stand.



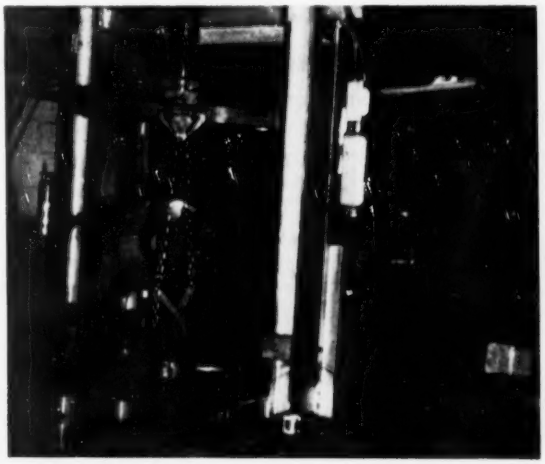
COMPACT SAND BLASTER for cleaning and polishing metal parts is a useful tool in the Electric Service Repair shop, Paterson, N. J. This unit is formed from sheet steel plates, with an inverted pyramid base to catch dropping sand particles, and a suction fan above the assembly to remove dust from the enclosure. Finely pulverized sand is blown into the chamber through a nozzle arrangement, and this sand blast plus the backing air pressure is regulated by a foot pedal.

The front section of the compartment is hinged at the bottom, held closed by rotating latches, and fitted with two arm holes for the operator. Conical rubber sleeves that fit around the operator's wrists are secured beneath circular gaskets that encircle the arm holes, and the operator is further protected by rubber gauntlets. He can thereby rotate parts being polished and, with the aid of a vision panel and light inside the hood, observe the progress of the work.



WIRE DE-REELER finds constant use in the shop of Lockwood's Electric Motor Service in Trenton, N. J. Originally designed to aid handicapped veterans perform routine coil winding operations with minimum effort, it has proved to be so advantageous to everyone in the shop that additional units were made for general use.

The unit is formed from eight sections of diamond-grid steel plate, welded together to form an octagon-shaped cylinder. Two spindles were welded to each section, threaded to engage round wire de-reelers, so that 16 reels of variously-sized wire may be supported by the frame. The frame is easily rotated since the shaft of the octagon is bearing-supported and the operating crank has an 8-to-1 gear ratio. The frame is secured in the desired position by a rachet lock which may be released by foot treadle for further rotation.



DAMAGED COILS are pulled from the slots of stators by means of chain tongs operated by an overhead motor in the shop of the Standard Electric Motor Repair Company, Linden, N. J. A cam arrangement and a hydraulic plunger cylinder provide a vertical pulling cycle. This equipment is mounted to the I-beam members of an arbor that surmounts a sheet steel working surface fitted with clamps for holding the stator in position.

Up and down movement of the plunger and tongs may be controlled by means of a foot pedal, and the operator can position the tongs around a different coil each time the cam places the chain assembly in its lowest position. In this manner coils are pulled from their slots quickly and with little effort. Also, since they are pulled out in almost a truly vertical direction, slot edges are not damaged.

1 Concrete standards are unloaded from flat trailer and spotted along shoulder by boom truck. Pre-stressed units weigh about 2,200 pounds each.

2 Jeep trenchers, one on each side of dual highway, roll along in third gear, dig about 100 feet of 30-inch trench per hour.

Mechanization Paces

Superhighway Lighting Installation

. . . for Eden's Expressway skirting Chicago's north shore suburbs. Monroe Electric Co., Chicago, and Contracting and Material Co., Evanston, light 14-mile project.

By August Eckel

MECHANIZED techniques and systematic operating procedures of two electrical contractors set a fast installation pace on a million-dollar highway lighting project designed by the Cook County Highway Department for the new Eden's Expressway skirting Chicago's north side and suburban residential areas. Successful bidders, in open competition, were the Monroe Electric Company of Chicago and Contracting and Material Company of Evanston. Each is handling about one-half of the 14-mile project.

County highway department lighting engineers designed a mercury-vapor system to provide an average of one footcandle of illumination on the six-lane, 60 mph, concrete superhighway. Luminaires are the 400-watt, 20,000 lumen, Type EH-1 mercury-vapor units supported horizontally on 8-foot bracket arms on 30-foot prestressed concrete standards. Units are mounted in a staggered pattern 7½-feet back from the curb on each side of the dual roadway. Spacing averages about 195 feet between standards; those at the eight cloverleaf intersections are closer together.

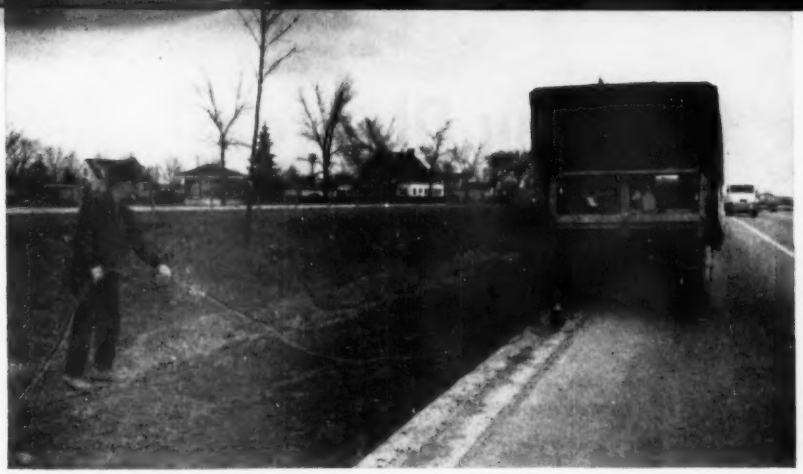
Distribution is of the 480/240, single-phase, 3-wire type with Neoprene-jacketed, Type USE, direct burial, insulated cables and a stranded bare copper conductor as a neutral. The complete system is served by ten independently operated power centers consisting of concrete, above-ground, vaults housing transformers and automatic control equipment. Each section of lighting served by one of these centers is controlled by an outdoor photo-cell (on conduit mast on vault) so regulated that when natural illumination from the north sky falls below a one footcandle level, the lights will go on automatically. When outdoor natural illumination reaches 1.5 footcandles, the lights are automatically turned off.

Time Control

Each power center has a unique supplementary control feature. Should highway department surveys indicate that less lighting will provide adequate safety beween the off-peak traffic hours of 1:00 a.m. and 5:00 a.m., alternate lights along the roadway can be turned off while traffic interchanges remain completely illuminated. To accomplish this, and the resultant saving in energy costs, an automatic synchronous time switch is incorporated in the circuits controlling the alternate lighting units. A ten-hour carry-over feature is provided to restore control to the photo-electric cells if this special timing equipment fails.

This is the lighting system the two contractors are now installing. Methods used to get the job done are left to the ingenuity of the individual contractor. The prime goal is to have the lighting operating and completed at the earliest possible date so motorists can benefit from this added safety feature.

The following sequence photographs show the installation techniques used by Monroe Electric to complete the first section of the lighting project. Wherever possible, mechanized procedures were used to the fullest extent. Speed was essential in this specific section to beat the sometimes unpredictable antics of Chicago weather. The technique worked and Monroe is now pushing the second half of their seven-mile stretch.



3 Cable truck follows trenchers, Mechanics lay two No. 4, stranded, Neoprene-jacketed, Type USE and one No. 6, stranded bare copper cable in trench which is immediately backfilled.

4 Poles are fitted with mercury ballast "can", bracket arm, luminaire and completely wired on the ground.

5 Earth boring unit on truck digs 20-inch diameter, 6-ft., 6-in. hole for standard in about 15 to 20 minutes. Flagman slows down and diverts high-speed traffic around truck.

6 Time is saved by using a second truck equipped with auger and boom. Immediately after hole is dug, same truck sets standard with high boom attachment.

7 Completely assembled standard is set, aligned and secured in post hole. Cable loops enter butt base below ground level, connections are made in handhole above ground.

PERTINENT STATISTICS EDENS EXPRESSWAY LIGHTING PROJECT

Total Length of Expressway (Six lane, 60 mph. concrete highway with center safety island)	14 miles
Number of Cloverleaf intersections	8
Number of Overpasses (Including intersecting ramps)	20
Total Number of Lighting Units	1,077
Average Spacing Between Units	195 feet
Type of Luminaire	400-watt, 20,000 lumen Type EH-1 mercury-vapor unit mounted in horizontal position. I.E.S. standard for Type III distribution
Mounting Height	32 feet above roadway, approx.
Type of Standard	30-foot, pre-stressed concrete, 2,200-lb., standard with a 6-ft. butt base; pole top mercury ballast adapter and 8-ft. aluminum bracket arm
Distance Between Curb and Standard	7½ feet
Distribution System	480/240-volt, single-phase, 3-wire with direct burial Type USE cable and bare copper neutral
Service and Control	Service of lighting sections from concrete above-ground transformer vaults. Control by means of photo-electric cells on conduit mast above vaults
Average Illumination Intensity	One footcandle, approximately
Total Installation Cost	$1,000,000, approximately

Plans for New Plants and Equipment

What does industry plan for plant expansion, modernization and new equipment in the next few years? McGraw-Hill's sixth annual survey discloses current plans and trends for capital expenditures are swinging from expansion toward modernization.

BUSINESSMEN plan to increase manufacturing capacity by 16% between now and 1956. By 1956, they also expect sales in manufacturing to increase by 10%. This is not a forecast but a statement of business plans and expectations based upon replies to the sixth annual McGraw-Hill survey of large business firms. Businessmen also report that they plan to introduce new products and install new processes which will require large capital expenditures.

Capacity Plans Still On Upgrade

Industry plans to increase capacity in manufacturing by 7% in 1953, and then by another 9% by 1956. The biggest expansion in capacity, as shown in Table 1, is planned in the electrical machinery, transportation equipment, and chemical industries. Automobile and machinery makers expect to expand faster than the average of all industry over the long pull, 1953-56. The oil industry, long regarded as a pace-setter in business, plans to grow at about the average rate along with the rest of manufacturing. Food and other manufacturing companies plan modest, but still important, increases in capacity. The steel industry is definitely slowing down its rate of expansion.

A transition from defense to civilian production, beginning in 1953 and extending to 1956, is indicated by these capacity plans. Some of the defense-supporting industries, such as steel and non-ferrous metal producers, plan to complete large increases in capacity during 1953. But they do not plan to add very much more to their production potential by 1956. The durable consumer goods industries, such as automobile and electrical manufacturers, plan sizable increases in manufacturing capacity during the next four years. Consumer soft goods industries, such as food and apparel, expect to expand more slowly.

Plans for capacity are proving to be an unusually accurate indication of businessmen's thinking on their productive needs in relation to markets.

New Products and New Processes

With stiffening competition looming ahead, new products and new processes assume great importance. New products are a powerful competitive means of bringing in new customers and capturing a bigger market. New manufacturing processes are the key to increasing efficiency and lowering production costs.

Manufacturers were asked what new products or new processes in their industry would require particularly large capital expenditures during the next few years. Here are examples of what they expect:

Automobile makers expect to develop gas turbines for automotive engines. These will require wholly new kind of parts. New high compression engines in the more immediate future will require better parts. Both of these developments will call for large capital spending.

Airlines will replace present piston engines with turbo-jet types. New jet aircraft will also be needed as additional equipment, not replacements for present fleets, within the next seven years.

Chemical companies say that coal hydrogenation may reach the stage where it will require large capital investment. This is a process of getting new chemicals out of coal. More synthetic detergent plants, more petrochemical derivatives, and vertical integration of chemical companies are also planned.

Petroleum companies expect that catalytic reforming to improve motor fuels will require large capital expenditure.

Coal companies foresee the need for more continuous coal mining machines.

Food manufacturers will increasingly use the high-temperature, short time method of canning. This produces canned foods with more natural flavor and color at lower cost. Continuous bake ovens which use a steel conveyor band will find increasing use.

Industrial electrical wiring and equipment is a large and vitally important segment of the market for the goods and services of the electrical construction, installation and maintenance industry. Wiring, lighting, apparatus and equipment are essential components of industrial building, expansion, alteration and modernization. The prospects for capital expenditures by industry on plants and equipment are, therefore, a significant measure of the prospects for our own industry.

This report was prepared by the Economics Staff of McGraw-Hill which has charted annually plans for capital expenditures by industry for six years. An especially significant trend disclosed by the report is the swing to modernization. The electrical share of the modernization dollar is substantially more than for new plant work.—W. T. S.

With production of canned and baked goods being stepped up in these ways, pneumatic conveyors for handling bulk materials will be needed to keep up an adequate flow of materials. Higher speed filling and packaging equipment will also be necessary to keep pace with production.

Electronics manufacturers expect to continue investing in new equipment to produce larger picture tubes, color television, transistors, micro-wave application, and atomic energy power elements.

Machinery makers say their horizon includes larger forging presses, large injection molding presses, powder metallurgy, and more carboloy-tipped tools.

Can makers are going in for tinless containers.

Lumber industry expects to make more low cost building panels from wood waste and to invest in electronic gluing equipment.

Railroads still have a way to go on dieselization and beyond that is Centralized Traffic Control.

Steel companies plan to expand the processing of taconite rock, a low grade iron ore.

Textile manufacturers say that drastic changes in spinning mills are coming in about five years and in looms in ten years.

Transportation equipment companies have large expectations for high pressure rubber forming presses.

Expansion vs. Modernization

A marked shift toward modernization can be seen in the following percentages of total capital spending:

	Percent Spent on	
	Expansion	*Modernization*
1951	58	42
1952	49	51
1953 planned	43	57
1954-56 (preliminary plans)	38	62

Table 3 indicates that industries in which total spending is declining are the ones which expect the largest portion of their funds to go toward modernization and replacement. The steel, transportation equipment, food, and textile industries particularly show a strong tendency toward modernization expenditure.

Amount of Capital Investment by Major Industries

The amount of capital expenditures planned by business is still rising. In this survey, consisting mainly of large business firms, businessmen indicated plans to spend $23.3 billion on new plant and equipment in 1953. This is a 6% increase over 1952. Manufacturing firms expect to invest about 1% more than last year, while gas and electric utilities, airlines, and mining plan more sizable increases.

The outlook for 1954-56 shows business already projecting capital plans at a level well over $18 billion each year. By comparison, industry's capital spending in the peacetime prosperity of 1947-50 ranged between $14 and $16 billion a year.

While total capital spending plans continue to rise in 1953, some industries are cutting their investment programs while others go on expanding. By and large, the plant and equipment expenditures in 1953 will be supported by as broad a group of industries as in 1952, but the base will be narrower than in 1951.

In 1951 business expanded plant and equipment sharply across the board, defense and consumer industries alike. During 1952, fewer indus-

TABLE 1

HOW MANUFACTURING INDUSTRIES ARE INCREASING CAPACITY

Index of Industrial Capacity (1939=100)

	1946	1948	1950	1951	1952	Planned for 1953	Planned for 1956
Steel	112	115	126	130	140	146	147
Machinery	154	200	236	271	304	331	371
Electrical Machinery	175	280	325	354	400	452	560
Automobiles	104	130	153	170	196	210	235
Transport Equipment (including aircraft)	243	250	288	328	423	503	553
Food	117	135	143	152	157	163	178
Chemicals	172	250	293	322	357	393	479
Petroleum Refining	123	160	178	185	194	204	218
Other Manufacturing	109	120	133	141	148	155	166
ALL MANUFACTURING	131	156	175	187	204	218	238

	Percent Increase 1951-52	Percent Increase 1952-53	Percent Increase 1953-56
Steel	8	4	1
Machinery	12	9	12
Electrical Machinery	13	13	24
Automobiles	15	7	12
Transport Equipment (including aircraft)	29	19	10
Food	3	4	9
Chemicals	11	10	22
Petroleum Refining	5	5	7
Other Manufacturing	5	5	7
ALL MANUFACTURING	9	7	9

TABLE 2

HOW INDIVIDUAL INDUSTRIES EXPECT THEIR SALES TO INCREASE

(average percent increase by 1956)

	Increase in Sales Expected For Industry
Steel	3
Machinery	6
Electrical Machinery	22
Automobiles	19
Food	10
Chemicals	21
Petroleum and Coal Products	14
Textiles	8
Other Manufacturing	7
ALL MANUFACTURING	10

TABLE 3

WHAT COMPANIES PLAN TO SPEND FOR

(Expansion versus Modernization)

	1952		1953		1954-56	
	Exp.	Mod.	Exp.	Mod.	Exp.	Mod.
	%	%	%	%	%	%
Steel	62	38	41	59	22	78
Machinery	55	45	50	50	52	48
Electrical Machinery	57	43	60	40	49	51
Automobiles	36	64	28	72	52	48
Transport Equipment (including aircraft)	77	23	55	45	17	83
Food	28	72	45	55	17	83
Chemicals	76	24	71	29	67	33
Petroleum & Coal Products	42	58	40	60	39	61
Textiles	30	70	17	83	11	89
Other Manufacturing	42	58	37	63	31	69
ALL MANUFACTURING	49	51	43	57	38	62

TABLE 4

BUSINESS CAPITAL EXPENDITURES

(millions of dollars)

	Actual	Planned	Preliminary Plan		
	1952*	1953	1954	1955	1956
Steel	1,538	1,246	748	623	785
Machinery	772	749	577	532	502
Electrical Machinery	376	549	483	395	302
Automobiles	896	1,066	949	768	693
Transport Equipment (including aircraft)	253	309	182	56	37
Food	785	879	686	677	677
Chemicals	1,451	1,364	1,309	1,228	1,350
Petroleum & Coal Products	2,596	2,908	2,792	2,588	2,530
Textiles	400	396	368	305	281
Other Manufacturing	2,927	2,634	2,028	1,817	1,817
ALL MANUFACTURING	11,994	12,100	10,122	8,989	8,974
Mining	880	1,003	832	682	692
Railroads	1,391	1,210	823	835	871
Electric & Gas Utilities**	4,750	5,083	5,572	5,467	5,467
Other Transportation & Communication	2,961	3,139	3,305	2,741	2,456
ALL INDUSTRY	21,976	23,335	20,654	18,714	18,460

*United States Department of Commerce
**ELECTRICAL WORLD, American Gas Association

tries continued to increase their investment, and these industries were mainly among the defense supporting group. Steel, machinery, petroleum, chemical, food, and electric utilities showed the greatest increases in plant and equipment expenditures in 1952.

According to business plans for 1953, steel, machinery, and chemical industries will decrease their capital expenditures somewhat. Food and petroleum will continue to increase their capital spending at about the same rates as last year. But the big increase in capital investment in 1953 will come in automobiles, electrical machinery, transportation equipment, mining, and utilities.

Capital Investment by Product Lines

The largest increases in capital investment programs by product lines are found in agricultural machinery, office and store machinery, paper and oil refining. Other groups, which are making large increases in plant and equipment expenditures are airlines, gas utilities, shoes, furniture and engines. Among the food group, beverages, breweries, distilleries, and dairy products plan bigger capital programs.

Products with less capital spending in 1953 than last year include paper, glass, non-ferrous metals, food canning, most lines of machinery, and rayon chemicals.

Range of Capital Investment, 1954-56

How firm are these capital investment plans of business? Will they change sharply if business conditions change?

Business plans for capital investment are flexible, but there is more leeway for them to go upward than down. All manufacturing companies have preliminary plans to spend an average of about $9.3 billion a year in the period 1954-56.

Compared to this, the minimum annual expenditure they say they would make even *if sales declined substantially* is about $6.0 billion. In a business recession, therefore, manufacturers do not expect to cut their investment in new plant and equipment by more than one-third.

On the other hand, the maximum capital expenditure businessmen feel they could make in the period 1954-56, to take full advantage of all technological developments, amounts to about $13.8 billion. This is almost half again as high as the preliminary plans for expenditure during this period. Capital spending in 1954-56 would be well above the level of 1952-53 if businessmen spend the maximum amount which they feel they could invest.

The biggest opportunities for increasing capital investment to take advantage of technical improvements are in the steel, machinery, food, chemical, petroleum, and textile industries. These industries have considerable latitude for modernization, judging from maximum spending businessmen report compared to their 1953 spending plans. By contrast, businessmen in the electrical machinery, automobile, and transport equipment industries do not think that the maximum level of investment which they could profitably make for technical improvements in the future would equal 1953 spending.

Depreciation Provides Firm Base of Financing for Investment

The most important thing about depreciation funds is that they are increasing. Depreciation in manufacturing will increase from $5.9 billion in 1952 to $7.8 billion in 1956, according to businessmen's reports.

Today depreciation finances a little more than half of the capital spending. Depreciation in 1953 will amount to $6.8 billion in manufacturing, com-

(Continued on page 243)

Common Code Problems

- Use of multi-wire Branch circuit
- Lightning hazard discussion

By B. A. McDonald

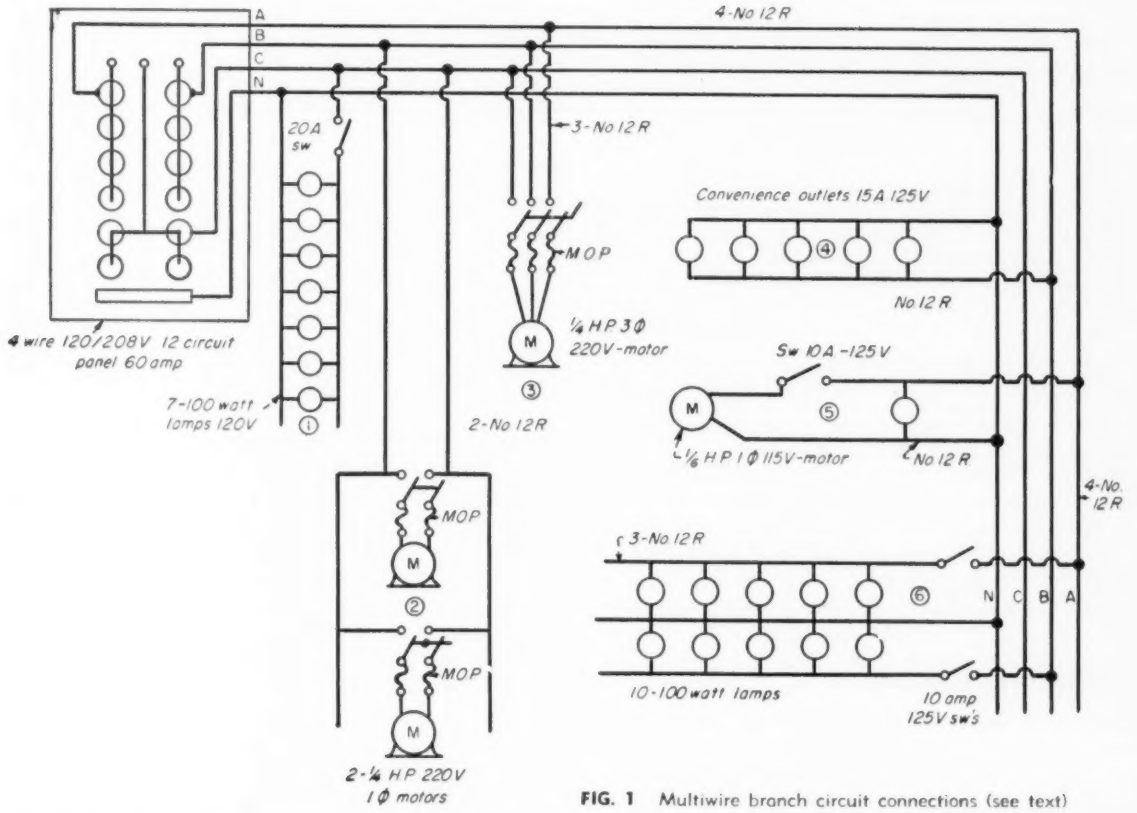


FIG. 1 Multiwire branch circuit connections (see text)

20 Ampere Branch Circuit

QUESTION: Can a 4 wire, three phase, 120-208 volt 20 ampere branch circuit be used in the manner illustrated? List Code violations, if any.—P.P.G.

ANSWER: A review of Code rules covering Branch Circuits, Article 210, shows under Section 2125-a that the total load permitted on the 20 ampere branch circuit is limited to 16 amperes when motor operated appliances are supplied. Section 2126-a limits the total rating of fixed appliances to 50% of the branch circuit rating if lighting units or portable appliances are also supplied. Section 2116 of the Code requires, where in normal operation the maximum load will continue for long periods of time, that the minimum unit loads specified shall be increased by 25%.

In view of the foregoing rules, the 20 ampere circuit may only be loaded to 16 amperes and if the circuit is in use for long periods of time each individual load shall be increased by 25%. In order to clarify the loading shown by you in Fig. No. 1, I have added Fig. No. 2 which shows the amperes per phase for the various unit loads shown which indicate that phase B with a load of 17.4 amperes is overloaded. If the load is used for long periods of time, the current values shown for each of the three phases and the neutral must be increased by 25%. This

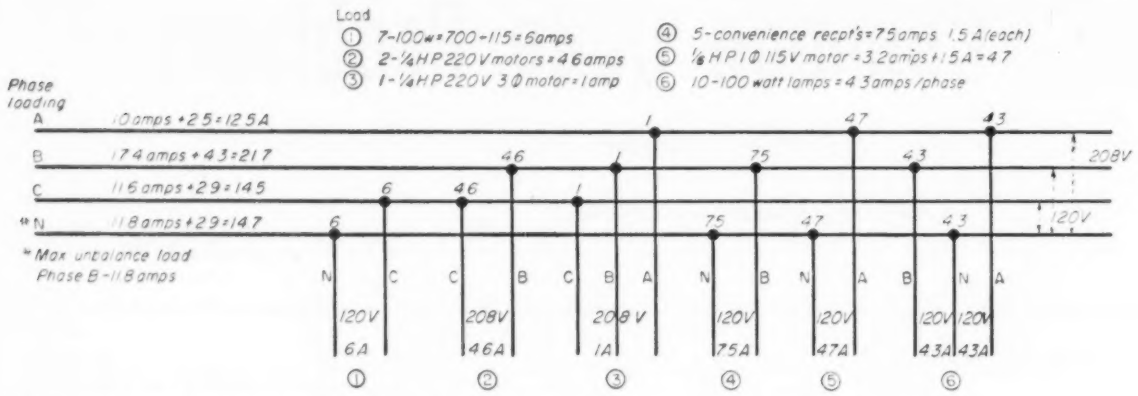


FIG. 2 Analysis of loading on multiwire circuit (see text)

factor, as shown in Figure No. 2, does not result in any further overloading of the circuit. In connection with the convenience outlets shown on (4) and (5) I have figured a minimum load of 1.5 amperes per receptacle as required by Section 2116-b, assuming that the occupancy in question is not residential. In figuring the load in terms of amperes I have used 115-230 volts as covered by example No. 1, page 389 of the Code.

Since the total rating of the fixed appliances is shown to be 4.6 A + 1 A + 3.2 A = 8.8 amps., which is less than 50% of the circuit rating, there appears to be no conflict on this point provided the question did not arise concerning the 80% penalty for motor operated appliances. There could be a question in applying this penalty to 20 amperes or 16 amperes. In the latter case there would be an obvious violation of the motor load on this circuit.

In addition to the foregoing, I notice that 220 volt motors are connected to a 200 volt circuit. Such procedure may influence the efficient operation of the motors, depending upon the use to which they are put.

Section 2111 recognizes the use of multi-wire circuits as shown in your illustration and it does not restrict the connection of loads operating at different voltages, such as the 220 volt motors and the 120 volt lighting. This procedure has been questioned in the past however since such a combination could result in motor failures when a fuse blows. As an example, if the fuse in phase C blew, the two ¼ hp motors shown by (2) would be connected in series to 120 volts through the lamp load shown by (1). Personally I do not believe that loads connected to multi-wire branch circuits should be recognized when operating at different voltages.—B.A.McD.

Lightning Hazard

QUESTION: Occasionally, there will be an installation where the impedance of the grounding circuit through the service cabinet, and cable assembly, will be as low, or lower, than the impedance of the service grounding conductor. If a building service such as this were called upon to dissipate a lightning stroke, the grounding conductor in the heater cable assembly would carry a current equal to, or greater than, the service ground. On Page 2241 of the Standard Handbook for Electrical Engineers, 8th Edition (McGraw Hill), K. B. McEachron and J. H. Hagenguth state that, to the best of their knowledge, a 4 guage solid copper conductor is the largest known to have been burned off by lightning. This seems to correspond with what linemen have told me; that while they haven't found any 6 gauge ground wires burned off, by lightning, they have observed evidence of severe heating of conductors of this size. However, McEachron and Hagenguth also mention (page 2237) that there have been cases, in laboratories and in the field, where excessive current has entirely eliminated a 14 gauge conductor, leaving the rubber apparently unharmed, so perhaps the fire hazard involved is not too great. Omitting the cable assembly grounding conductor would increase the possibility of a flashover at the service entrance, and heater element, and perhaps the resulting current carried by the heater supply conductor, or conductors, would be just as bad as to have it carried by a small grounding conductor.

Another item which has worried me is the bonding of the service ground to the lightning protective equipment, as the service ground wire is usually in contact with wood, or other combustible material and a 4 gauge (126.4 lb per M ft) or 6 g. (79.5 lb per M ft) ground wire is much smaller than required for lightning protective equipment (1875 lb per M ft). I realize that such equipment is also supposed to use the underground water system as the grounding electrode, which would make a parallel path, but there are many installations where this has not been done.

Should Article 2534 be changed to include all types of wiring, whether in metal enclosures or not? If we use figure 4-61 page 379 Standard Handbook for Electrical Engineers, it would seem that the Code Panel Members, who are responsible for 2534 must anticipate a possible potential difference between wiring and lightning protective equipment of nearly 750 kv. The insulated covering of non-metallic sheathed cable is an ineffective barrier

against pressure of such magnitude. If my information is correct, lightning is the largest single cause of farm fires, and is responsible for about 20% of the nation's annual farm fire loss.—S.W.

ANSWER: Since Section 2594 of the Code requires a minimum No. 8 conductor for grounding a wiring system and the size increases as the size of the service conductors increase; and the path to ground is shorter and more direct than that presented by the path through the water heater circuit which has conductors smaller than No. 8, I am unable to visualize an installation where the impedance of the grounding circuit on the load side of the service switch would be lower than the impedance of the system grounding conductor, provided terminal connections are made and maintained as required by Section 2613. The principle involved with system grounding is to provide a path to ground of normally low impedance and normally lower than any other path to ground. In the case of a lightning discharge, there is an instantaneous very high voltage and amperage resulting from the surge. It could be equivalent to millions of volts and thousands of amperes occurring in thousandths of a second. Under such conditions a system ground to a made electrode with a water heater grounded to a local water pipe system will result in insulation breakdown at the water heater. An interconnection between these two electrodes tends to eliminate such failures. In the March 1952 issue of the News Bulletin of the I.A.E.I. an excellent article with illustrations was published which clearly covers the additional protection obtained when such procedure, which is required by the Code, is followed. I am requesting Joseph Whitner of the Southeastern Underwriters Association of Atlanta, Georgia to send to you a copy of this article, if they are still available. I know from your comments that you agree with the principle involved but I feel that you also would be interested in the detail covered by this article.

In connection with your second question, I have added to your illustration the lightning rod installation and I question the connection which you have made between the system ground conductor at point A to the lightning rod conductor at point B. Section 2534 of the Code only requires metal enclosures of conductors to be bonded to a lightning rod conductor when it is impracticable to secure a 6-ft. separation. This rule does not apply to conductors. It does apply to conductor enclosures. This rule also provides for bonding only when it is not practicable to secure a 6-ft. separation. As a result the main objective is to keep metal conductor enclosures more than 6-ft. from the lightning rod conductor and I believe any situation where this could not be achieved would be rare. A similar provision also applies to metal frames and cases of electrical equipment as covered by Section 2546. In connection with your comments on Section 2534, there is a difference, in my opinion, between the hazard presented by conductor metal enclosures and conductors irrespective of the type of enclosure. In the case of metal enclosures, which ordinarily are grounded, we could have a low impedance path to ground while in the case of the conductor itself, we might expect a higher impedance path to ground. Section 2586 of the Code prohibits the use of lightning rod conductors, driven pipes, rods or other made electrodes to be used in lieu of the made electrodes required for the grounding of systems. The grounding connection between A and B shown in your illustration partially violates the intent of this Section, since we are grounding the lightning rod installation through the system grounding conductor and we also ground the electrical system through the lightning rod grounding conductor. I believe the main intent of Section 2534 is to keep metal enclosures of conductors separate from lightning rod conductors by at least 6 feet and I believe all of us should keep this requirement in mind when installing electrical equipment on a property that is protected by a lightning rod installation. The same comment equally applies to the installer of the lightning rods.

According to the 1952 October Quarterly of the N.F.P.A. which publishes and classifies the fire loss for 1951, we find on the basis of 15 States reporting that out of 159,179 total fires, 12,996 were caused by lightning, which is approximately 8%. The total fire loss amounted to $132,452,600, of which $5,847,458 was due to lightning, approximately 4.5%. It is very noticeable however, that out of the 12,996 total fires due to lightning, 10,660 occurred in the State of Wisconsin. This high ratio was not true however for the fire losses due to such fires. The total fire damage due to lightning was $5,847,458 out of which $1,550,484 was lost in the State of Wisconsin. These figures indicate that fires due to lightning in Wisconsin run high when compared with other States. Out of a total of 31,503 fires in this State, 10,660 were due to lightning. The average loss per fire however was very low, about $150. In view of the foregoing record, it appears that particular attention should be given this problem by emphasis on the need for standard well maintained lightning rod installations, and I suggest that you obtain from the National Board of Fire Underwriters at 220 West Adams Street, Chicago 6, Illinois, their booklet on "Nature's Artillery" which covers the subject of Lightning Protection.—B.A.McD.

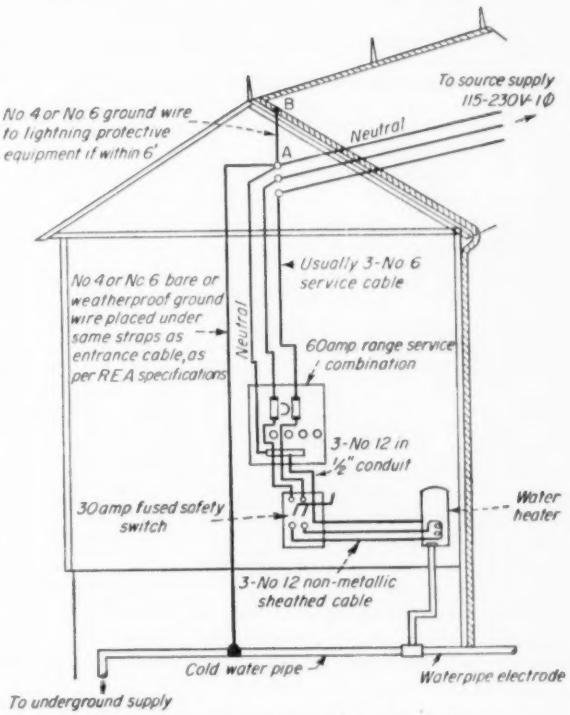
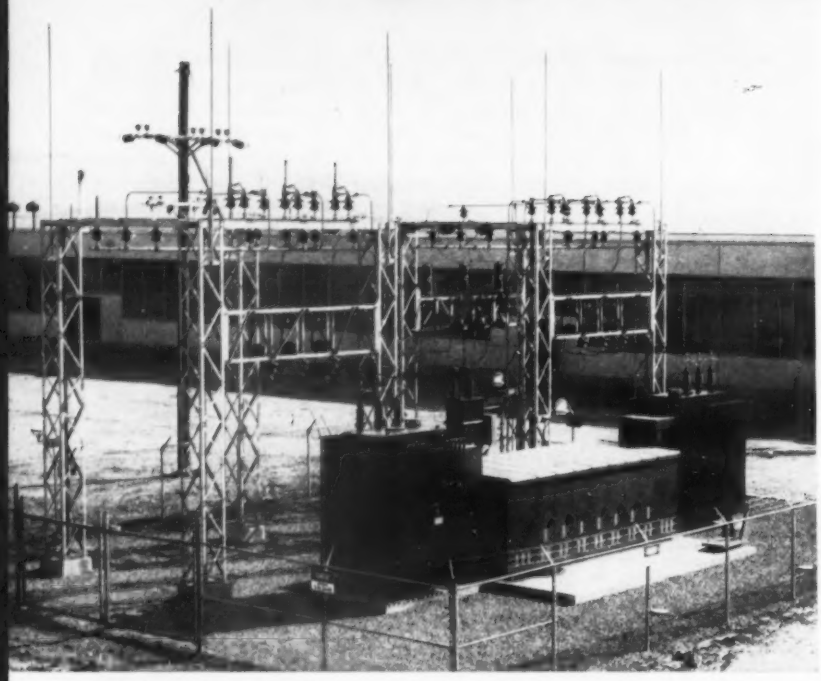

To source supply
115-230V-1Ø
No 4 or No 6 ground wire to lightning protective equipment if within 6'
B
A
Neutral
No 4 or No 6 bare or weatherproof ground wire placed under same straps as entrance cable, as per REA specifications
Usually 3-No 6 service cable
Neutral
60amp range service combination
3-No 12 in ½" conduit
30amp fused safety switch
Water heater
3-No 12 non-metallic sheathed cable
Cold water pipe
Waterpipe electrode
To underground supply

FIG. 3 Lightning grounding connections (see text)



OUTDOOR SUBSTATION was specified, manufactured and erected as a coordinated, ready-to-install packaged unit. Twin 3000-kva 23/4.16-kv transformers serve common bus and five electrically-operated draw-out secondary feeder breakers.

"Packaged" Electrical Distribution

By Hugh P. Scott

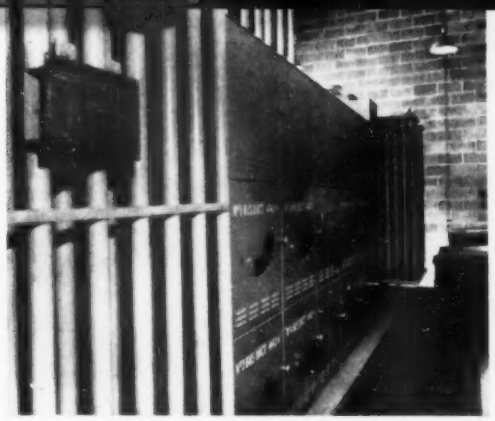
Factory-assembled substations, switchgear and distribution components—delivered as ready-to-install units—provide guaranteed, coordinated electrical performance, minimize local engineering problems and reduce assembly procedure. This is emphasized in $4-million plant erected for Daystrom Instrument Division. Electrical construction was by John VanDorick, William S. and Dory L. Hammerman.

THE fact that a coordinated, efficient, flexible electrical system can be designed and erected economically by using standard factory-assembled "packaged" components is effectively proved by considering the $4-million 400,000-square-foot plant recently completed for Daystrom, Inc., on the outskirts of Scranton, Pennsylvania. In this up-to-the-minute industrial enterprise, complete substations, switchgear and prefabricated steel structures were specified, manufacturers' standards for busduct and underfloor-duct distribution were followed closely, a high-level illumination system was combined with a protective automatically-switched emergency lighting installation, and sequence-starting control apparatus provides "foolproof" operation of motorized equipment. Designed by architect F. Clifton Pearce, this modern electrical system was installed by three local contractors: John VanDorick, William S. Hammerman and Dory L. Hammerman. These men combined their organizational resources, supervisional know-how, installation equipment, field crews and purchasing powers to rush the job through to completion.

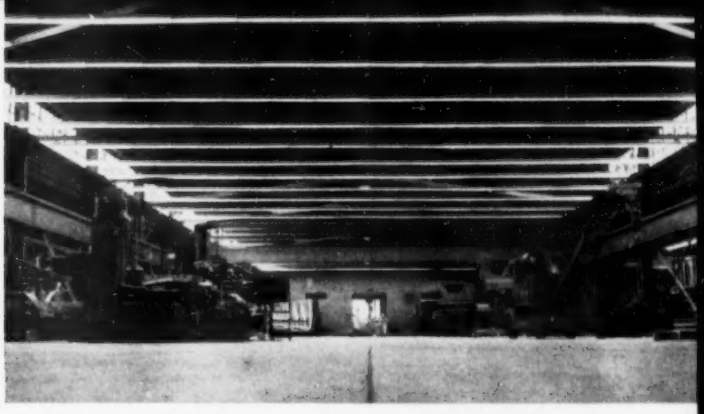
In designing this installation, the repeated use of "packaged" components was prompted by several reasons. For example, in selecting complete factory-assembled substations, it was logically argued that these centers—if engineered and constructed by a single manufacturer—would have matched, coordinated parts. This should result in a higher overall efficiency than would be possible by ordering transformers, buses and bus supports, disconnecting switches, steel structural members, station lighting and relaying equipment from various companies, then having to assemble and coordinate these parts in the field. It was further reasoned that ordering a substation as a completed ready-to-install item would save delivery time, preclude the possibility of omitting minor items of equipment, simplify ordering, conserve installation time, be more economical in the long run, pinpoint responsibility for performance to a single source and, as a result of all these contributing factors, provide optimum performance at minimum expense.

This reasoning is apparent in the outdoor 6000-kva 23kv/4160-volt 3-phase substation which combines a unified overhead steel structure, parallel horn-gap disconnects and high-tension cutouts, two 3000-kva transformers connected through secondary breakers to the ends of a 4160-volt bus structure, and five electrically-operated roll-out feeder circuit breakers for radial subtransmission distribution to interior load centers.

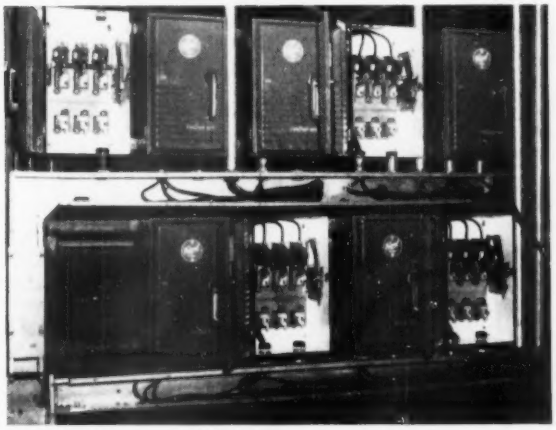
Delivered by a single manufacturer as coordinated sections consisting of standard factory-assembled units, it



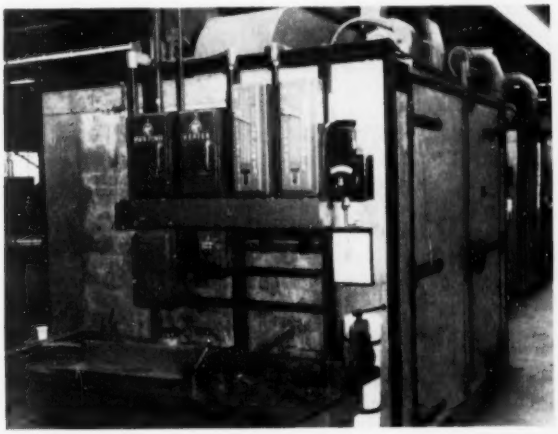
INDOOR LOAD CENTERS combine two 4160/440-volt transformers with each bank of metal-clad switchgear. Substations receive primary current via AVL cables in underground asbestos-cement ducts.



FLUORESCENT LIGHTING in manufacturing areas, obtained from 4-lamp commercial fixtures mounted in continuous rows, provides 35 footcandles at working levels. Control is from narrow column-type panels mounted between the flanges of vertical structural members.



SQUARE METAL WIREWAYS are used at control centers to provide liberal wiring space and permit re-routing or installation of circuits, when and if required, without disturbing already-established connections.



SEQUENCE SWITCHING for apparatus containing several motorized devices, such as this electric oven containing heaters and blowers, is facilitated by numbered switch enclosures that indicate the order in which switches are to be activated.

was erected with the aid of truck-mounted cranes on a concrete foundation pad poured prior to the delivery of substation components. As sections were hoisted into position they were shimmed for alignment, bolted together, then connected for service.

Since the 4160-volt bus constitutes a secondary tie between the two transformers, either of these two units may be removed from service for maintenance or repair without interrupting continuity of power passing to load centers. This station is equipped with removable manual maintenance closing devices, transfer truck and inspection test cabinet for circuit breakers as well as test plugs for draw-out meters and relays. The entire station is fenced and lighted for night-time protection and inspection.

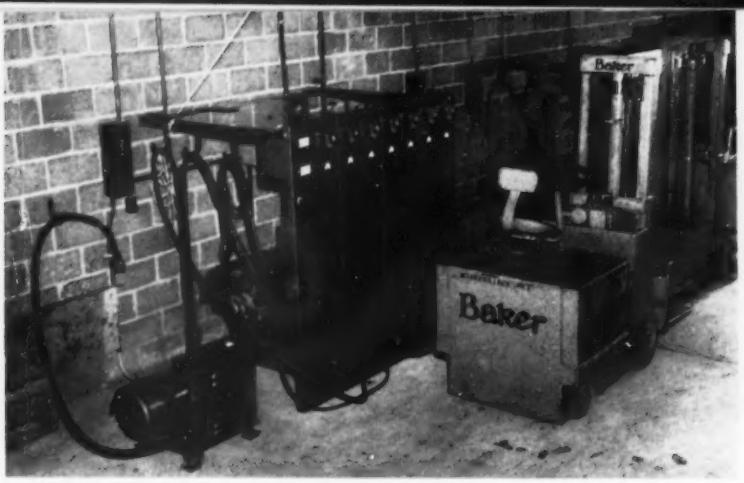
Secondary power is carried into the plant proper via AVL cables through underground asbestos-cement ducts sheathed in concrete, terminating at two 4160/440-volt load-centers. Each of these centers incorporates two transformers: 1500-kva units installed at one center, 1000-kva units at the other.

Following the same reasoning that dictated the selection of a "packaged" outdoor substation, both of the indoor load centers are completely factory-assembled units combining askarel-insulated transformers with metal-clad air-breaker switchgear. Components were trucked to the premises ready to install, and installation required only the establishment of foundation channels, the leveling and bolting of transformers and cubicles, and the completion of necessary connections with power feeders and plant distribution equipment. These packaged load centers also minimized local engineering problems, purchasing details and assembly procedures, resulting in an easy to plan, easy to order, easy to install, safe, flexible installation.

Busduct Network

Distribution through the plant is at 440-volts, carried by 600-amp 3-phase 3-wire plug-in busduct supported at 5-foot intervals and adequately sway-braced. Bus expansion joints are installed across all structural expansion lines and transposition joints are positioned at quarter- and half-points of all runs.

For voltage requirements below 440, dry-type transformers are connected to the 600-amp bus network through plug-in breakers and/or fusible safety switches. Dry-type transformers include both single- and 3-phase units with capacities generally of 150-kva or less. Collectively they provide voltages of 110/220, 115/230 and 120/208 for various testing, power tool, pump, fan, small motor, heating and lighting applications. Branch circuits are generally installed in rigid steel conduit, mounted exposed in manufacturing and



BATTERY CHARGING racks are used by the plant maintainance department to keep 22 industrial fork-lift trucks continuously in operation. Maintainance electricians also inspect, clean and repair motors, power tools, lighting equipment and distribution components.

SUSPENSION METHODS for lighting fixtures, busduct and conduit include C-clamps attached to roof beams, such as those shown in this illustration.

service areas, and run concealed in the floors, walls or fill in office sections. Where conduit is contained in cinder fill, it is first encased in concrete and, where electrical and steam lines cross or run parallel to each other, at least 6-inches clearance is provided and asbestos pipe covering is installed for heat insulation. All branch wiring is single conductor rubber covered; RH being used for inside and dry locations, RW for locations subject to moisture. Wire is solid up to No. 8 gage, standard for No. 6 and larger, with splices only at outlet- or junction-boxes. Soldered splices, rubber and friction taped then painted with air-drying varnish, are used for wire smaller than No. 6. Split-sleeve connections and the same type of insulation are used for larger sizes. Color coding conforms to NEMA standards.

Throughout the office building, 2-duct underfloor fiber raceways are installed to carry telephone circuits and 110-volt power wiring. Wherever these ducts pass beneath portable partitions, they are fitted with threaded inserts and conduit nipples so that direct connections can be made with partition-incorporated duplex receptacles placed 10-inches above the finished floor level. Wall receptacles not immediately adjacent to underfloor runs are connected to fiberduct junction boxes by means of $\frac{3}{4}$-inch conduit, while home runs from junction boxes are via $1\frac{1}{4}$-inch rigid conduit.

Where low-voltage power is required at work- or test-benches, it is furnished through sections of narrow plug-in surface-duct mounted along the front edges of benches and fitted with grounded 3-prong plug outlets.

Sequence Operation of Controls

At control centers and floor-recessed distribution in manufacturing sections, square metal wireway is used in order to permit plenty of room for tapping and splicing and to allow easy inspection, re-routing or installation of additional wiring without disturbing already-established circuits. At all control centers, switch panels are plainly *lettered* to indicate the equipment they control and, where several controls pertain to the same piece of apparatus (such as an electric oven containing heaters, blowers and exhausts) all switch enclosures and pushbutton stations are also *numbered* to insure that operation follows a prescribed sequence.

Wiring for lighting in the office sections is carried overhead between the furred ceiling and Q-section aluminum

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The construction of the Daystrom plant is part of an amazing story on community cooperation, for three local electrical contractors combined their engineering, installation and purchasing potentials to install the switchgear and distribution system, and thousands of Scranton citizens cooperated with their local Chamber of Commerce by buying stock in the amount of $600,000 which was loaned to Daystrom to help finance construction costs. This financial arrangement is now known as a LIFE project, that is, a Lackawanna Industrial Fund Enterprise. The program has been widely acclaimed as an outstanding example of a community's success in its own behalf to promote new industries, expand existing ones and thereby solve a critical local unemployment problem.

Since its inception, this public stock-backed method of raising funds for new construction has prompted the erection of 41 new plants and the expansion of 60 other existing companies in the area. It has added 2 million square feet of industrial floor space to the community's total, has created $10-million of appraised valuation, and has resulted in approximately 8000 new jobs with an estimated annual payroll of $18-million.

In operation, a LIFE-built plant is erected in accordance with specifications dictated by a responsible well-established firm (such as Daystrom). No salaries or fees are paid to LIFE trustees. Administrative expenses of the corporation are borne by the Scranton Chamber of Commerce, and the revolving base fund is replenished annually by public subscription.

This cooperative venture on the part of thousands of people from all walks of life has changed the future of this industrial city and its significance has been widely recognized by other communities now following Scranton's progress. This is a practical example of a community's faith in its own destiny, for it is solving a local problem without requesting state or national assistance.

roof panels of this single-story building. Illumination in these sections is in the order of 50 footcandles on desk tops, provided by 4-lamp louvered fixtures surface-mounted end-to-end on the 10-foot ceiling on 10-foot centers.

Lighting in the manufacturing areas is likewise fluorescent, with 4-lamp commercial fixtures continuously suspended either by messenger cables or hanger rods secured to roof-beam flanges by means of C-clamp anchors. Lighting levels here are 35-fc, while control is from narrow column-type panels mounted in the webs of structural H-members.

Throughout the plant there are a total of 2200 eight-foot Miller fixtures, 780 four-foot Keystone units and 180 special Holophane luminaires. All relamping is on a group-replacement basis at approximately 4500-hours of service. This relamping, plus cleaning and testing of other components, requires the continuous employment of a 2-man team working from a rolling scaffold. This arrangement has proved safe, convenient, fast.

Emergency lighting for offices, manufacturing areas, paint room and doctor's office is provided by completely separate circuits. Normally served by a 10-kva dry-type 115/230-volt 3-wire single-phase transformer connected to one of the 440-volt plug-in busducts, this emergency system is powered in times of utility failure by a 15-kva water-cooled gasoline motor-generator set equipped with belt-driven fan and centrifugal circulating pump for cooling purposes.

This unit is started and the lighting load is shifted to it by an automatic transfer switch when utility ac power fails. The shift back to normal service is likewise automatic when utility service is restored. M-g starting is by battery, with batteries kept at full potential by a trickle charger. All fixtures on the emergency system are standard stem-mounted RLM reflectors mounting 100-watt filament lamps. And, since the present total connected emergency load is only 8500-watts, the 15-kva m-g set provides ample insurance for adequate capacity.

Lighting for exterior parking lots and fence lines is provided by floodlight units mounted along the parapets of the main buildings. Inter-connection between lights is via No. 10 wire, run in conduit inside the buildings. Floodlight circuits are controlled by time switches.

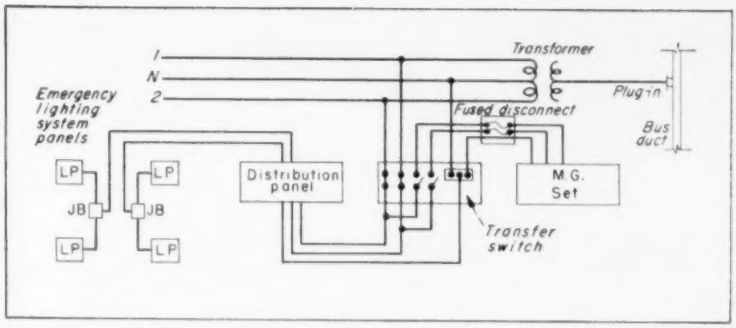
Electrical Maintenance

To keep this plant operating at peak efficiency requires a maintenance department of 87 electricians, mechanics, plumbers and carpenters. Of this total, the largest single group is electrical, employed for relamping and cleaning of lighting fixtures as already mentioned, motor inspection and repair, reconditioning power tools, servicing materials-handling equipment, modifying or expanding the distribution system and the like.

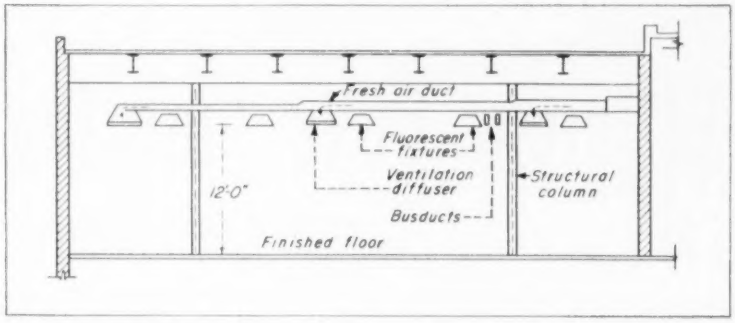
This maintenance program follows a definite schedule of equipment inspections, using detailed check-lists and procedure outlines to preclude the neglect of minor items. It also attempts to analyze the reason for each fault or shut-down, then to correct the cause of trouble rather than to merely repair the results of that cause.

This maintenance program is backed by a minimum of paper work, records being limited to important electrical system plans, motor records, test data, material inventories and cost records. System plans are kept in order to eliminate confusion when identifying feeders, revamping or extending branch lines, or making plant surveys of connected loads. Motor records are maintained so that case histories are available when recurrent repairs or faults are experienced. Test data is compiled so that operation can be adjusted to keep efficiency at a peak. Inventories are kept perpetually accurate to assure that replacement parts are kept in adequate supply. And cost records are compiled in order to intelligently evaluate the worth of man-hours devoted to testing, checking, cleaning, making minor repairs and adjustments.

In summary, it may be stated that three factors contribute to the efficiency of this plant. First, wherever possible and practicable, complete factory-assembled packaged distribution units were used to promote ease of planning, ordering, installation and operation. Second, the plant came into being through cooperation—on the part of Scranton citizens who participated in the LIFE program and on the part of the three electrical contractors who pooled their engineering, economic and physical resources. And third, modern methods and modern tools were used extensively during construction, and are now being employed to maintain the system at its designed operational peak by raising the efficiency of labor.

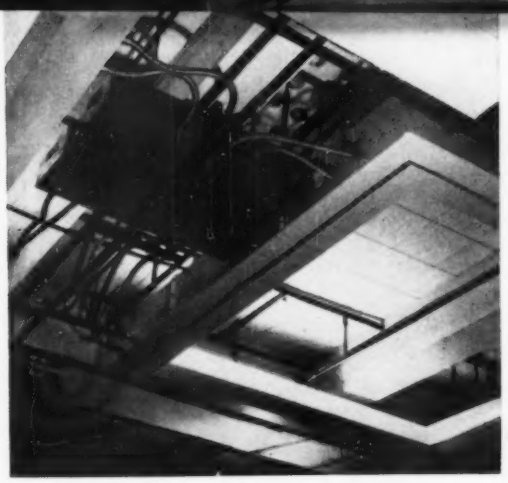


EMERGENCY LIGHTING system, normally served by dry-type transformer plugged into one of the 440-volt bus runs, is protected by a 15-kva motor-generator set and automatic transfer switch that shifts load to stand-by unit when utility service is interrupted.



MINIMUM CLEARANCE of 12 feet exists throughout the manufacturing building between finished floor and lighting fixtures, busduct and ventilation diffusing units, although this vertical distance is materially exceeded in high-bay sections.

INDIRECT LIGHTING from ceiling coffers provides 40 footcandles of highly comfortable illumination in offices of Sperry & Hutchinson Company, New York City. Slimline fluorescent lamps are used in coves.



BALLASTS which operate fluorescent lamps at 300 ma. are installed in ventilated metal housings located between metal coves.

Efficient Cove Lighting for Offices

By Berlon C. Cooper

A SPECIAL system of cove lighting, which has proved to be unusually efficient, was used recently to light two floors of a New York City office building. The lighting was part of a remodeling job which also included air conditioning, sound insulation, and repainting. The space is occupied by Sperry & Hutchinson Company, and the modernization was planned and specified by Guy B. Panero, engineers, who developed the unusual cove lighting system after a detailed study and analysis of the problem and existing structural conditions.

The building housing the two remodeled floors is of steel frame and brick construction. Columns are on 21 ft.-1 in. centers in one direction, and 22 ft.-1 in. centers in the other. The building is four bays wide and eight bays long, and the relighted general office areas are three bays wide and six bays long. Existing floors were of concrete; walls, plastered; and columns, furred and plastered two feet square. The existing ceiling was the plastered underside of the beams and slab. Ceiling heights to underside of slab was 12 ft.-3 in.; to underside of beams 11 ft.-3 in.; and to underside of girders 10 ft.-6 in.

In addition to the limitations imposed by the building construction, Sperry & Hutchinson imposed additional conditions. One was that the new offices have a suspended ceiling of acoustical metal pans, and that air conditioning ducts be concealed above this ceiling. Also, they specified that the lighting must conform to all of the following conditions:

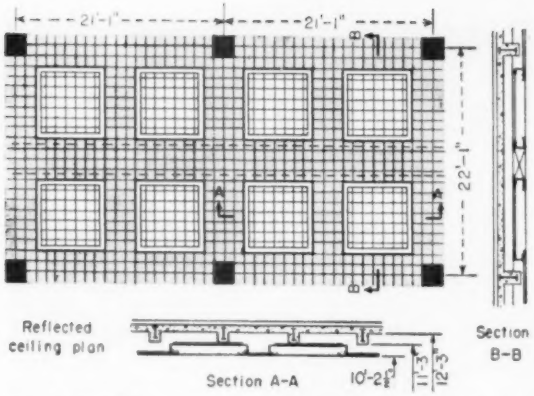
1. Provide optimum illumination.
2. Have low surface brightness.
3. Not be in the form of long narrow lines of light.
4. Lighting units shall not be of the surface mounted or suspended type.
5. Quality of illumination must not be sacrificed, even for economy.

The third condition automatically eliminated consideration of troffer lighting, or other linear types of fixtures. Because of the low ceiling height, a recessed type of fixture was considered the only acceptable type. A study of the conditions revealed that there would be room in the space above the suspended ceiling for both the air conditioning ducts, and some type of recessed lighting fixture.

One method considered for the lighting was to install four-foot squares in the ceiling, with rows of fluorescent lamps behind a diffusing screen, thus making use of standard lighting equipments. It was decided, however, that this method would result in a number of high intensity sources of direct light, leaving the ceiling space between lighting units comparatively dark. These dark spaces would appear as long dark lines and would be accentuated by the high surface brightness of the lighting unit. It was also decided that as long as fluorescent lamps were to be used for direct lighting, it would be extremely difficult to avoid a high surface brightness. In order to keep this surface brightness as low as practicable and also provide the required intensity of illumination, it was decided to provide a source of light which would be spread over the maximum ceiling area. Any attempt to use a recessed direct lighting unit larger than the four-foot square units, with the proper number of lamps to provide the same lumen output, would result in objectionable light and dark areas on the diffusing element as the lamps would have to be quite widely spaced to cover the large area.

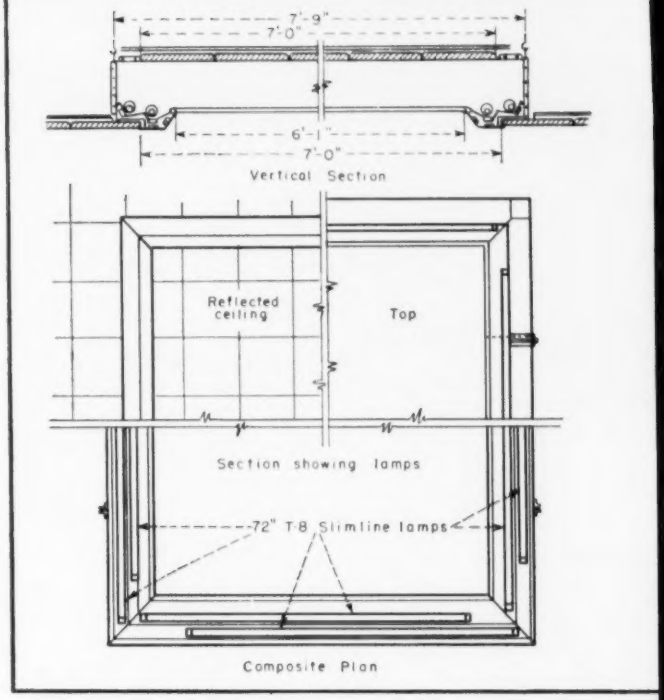
Further study indicated that the ceiling might be used as a reflecting surface for an indirect lighting system, since the acoustical tile under consideration could be furnished with a baked enamel finish having a reflectivity of 85%.

Since suspended fixtures were not to be used, the only other practical method of using indirect lighting was cove lighting. Room dimensions, however, made it impractical to consider



FOUR COFFERS are symmetrically spaced in each bay area of approximately 468 sq. ft. Acoustical tile 12-inch squares form general ceiling and coffer ceiling.

Use of slimline lamps in perimeter around coffer panels recessed in suspended ceiling provides high quality lighting efficiently with low surface brightness in a remodeled New York City office building.



EIGHT SLIMLINE LAMPS in metal reflectors light each coffer, which has a 6 ft.-1 in. square opening.

a standard cove around the perimeter of the room. Thus, the next step was to consider the use of a large number of recessed squares, or ceiling coffers. These squares could be indirectly illuminated by coves to almost any level, to satisfy all the requirements established by the owners.

In considering coffers, it was necessary to make them as large as possible, in order to keep the unlighted ceiling area between coffers as small as possible. It was finally decided to make these coffers seven feet square, so that they would fit into an opening seven acoustical tiles wide by seven tiles long. This made possible the use of four openings per bay, with the air conditioning ducts running between the coffers. With this arrangement, a beam crosses over each opening, providing a maximum space of 12½ inches as the overall depth of each fixture.

It was decided to use the same tile as a reflecting surface in the coffer ceilings as that used on the suspended ceilings. This results in an acoustical ceiling at two levels, and required a space of two inches under the beams to hang the coffer ceiling, leaving a depth of 10½ inches between the coffer finished ceiling and the main ceiling line.

It was desirable to illuminate the coffer ceiling uniformly; however, the limited depth available made this almost an impossibility. To do this required that a punch of light should be directed to the center of the coffer ceiling, requiring the use of an asymmetrical reflector. Consideration was also given to the use of a curved backwall and a straight backwall behind the lamps.

A preliminary design for the fixture was drawn up, in which an effort was made to fulfill all the requirements. This design was then submitted to several manufacturers with a request that they submit a design of a lighting unit which would meet the requirements shown on the drawing of the preliminary design, and submit bids for the work.

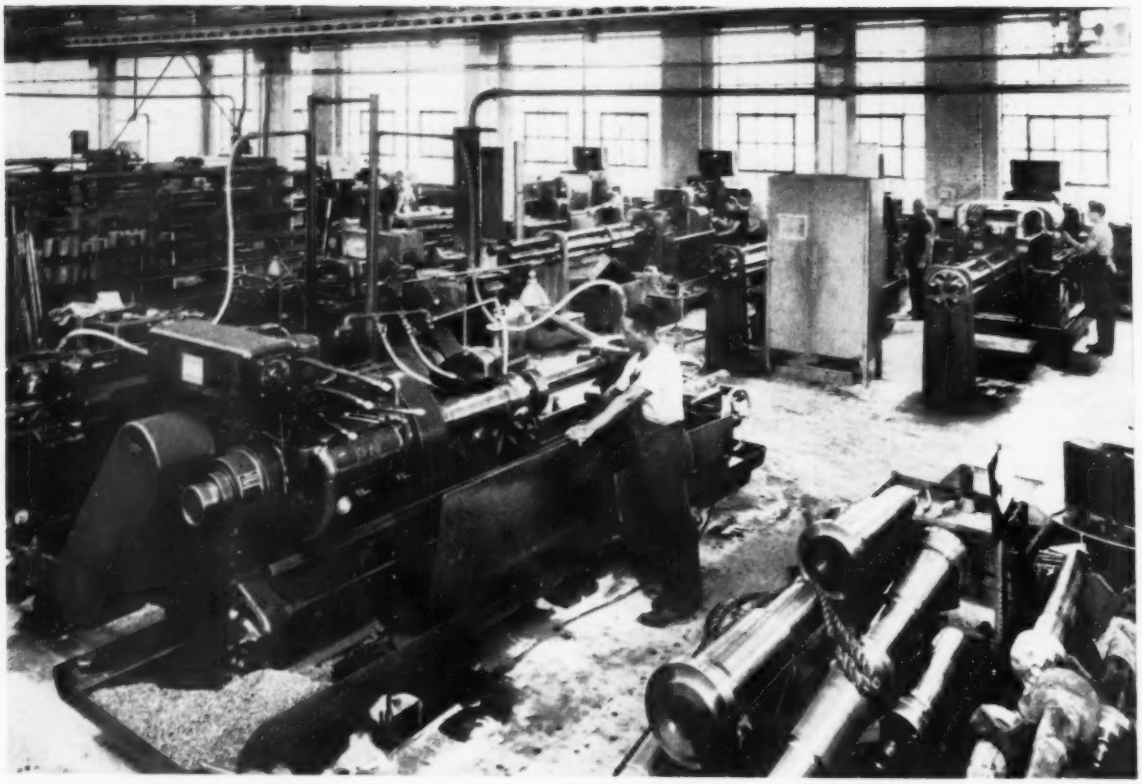
The successful bid covered a fixture which was almost identical with the preliminary design. A vertical backwall and an asymmetrical reflector were used, with a 5¾-inch lip. This left a 6 ft.-1 in. square opening, with an inset behind the tile opening of 4½ inches on all four sides. One-inch overlaps were provided at the upper and lower ceiling lines to assist in supporting the ceiling tile at the edge of the fixture. Details are shown in the accompanying illustrations.

Eight 72-inch T-8 slimline lamps are used in each coffer, and operated at 300 ma. each. Ballasts were installed in a metal ballast box located remotely from the coffer fixtures, in the space between coffers above the suspended ceiling.

Before fixtures were put in production a sample was produced by hand and installed on the job during construction. A check of lighting intensities indicated that design levels of illumination would result from the completed installation. The sample was then approved, with minor changes, and the fixtures were put in production and installed.

When the installation was completed, a survey was made after 200 hours of operation to determine the initial illumination. Directly under each coffer the intensity was 45 footcandles, and at the midpoint between four coffers it was 42 footcandles. Based on the total lumen output of the lamps in each coffer, a coefficient of utilization of about 38% is indicated, which is considered highly efficient for cove lighting systems. Subsequent checks on the illumination after a few months' operation reveal a surprisingly low rate of depreciation, which is attributed to the fact that the areas are air conditioned.

Condi-Lite Corporation made and supplied the lighting equipment, and the electrical work and installation of lighting units was done by New York electrical contractors Hatzel & Buehler, Inc.



TURRET LATHES, topping and threading machines, automatics and scores of other heavy-duty machines must be kept continuously operative to turn out W&S monthly production quotas. This necessitates preventive maintenance of the power distribution system, motors, cranes, lighting and hand tools.

Preventive Maintenance Meets . . .

PRODUCTION REQUIREMENTS

By Carl deCumbe

Maintenance Superintendent Warner & Swasey Company Cleveland, Ohio

ELECTRICAL continuity, uninterrupted operation of machinery and adequate lighting are three of today's most important essentials to high-output production. Ignoring this fact is unwise for any industrial organization, large or small, and attempting to reduce costs by omitting maintenance is truly false economy.

Maintenance costs money. Yet, when it prevents shut-downs, this expense is soon justified. In fact, in a plant such as ours where round-the clock operation is a necessity, it would border on economic suicide not to accept the benefits that are possible through routine inspections, planned repairs, a practical training program, adequate inventories and proper working tools. All these factors are part of a good maintenance program contributing to the reliability of all electrical facilities. This results in production of high quality at maximum speed on rigid schedules at minimum cost.

Here at Warner and Swasey, management not only places the responsibility for continuous production on the shoulders of the maintenance department, but grants us the authority to properly carry out this assignment. With responsibility and authority thus linked, it is possible to insist that electrical equipment be used for its intended purpose and operated properly, that it be connected to power lines not subject to overloading, that a realistic inspection schedule be followed and, when required, that planned shut-downs rather than forced break-downs govern repair time-tables.

Organization

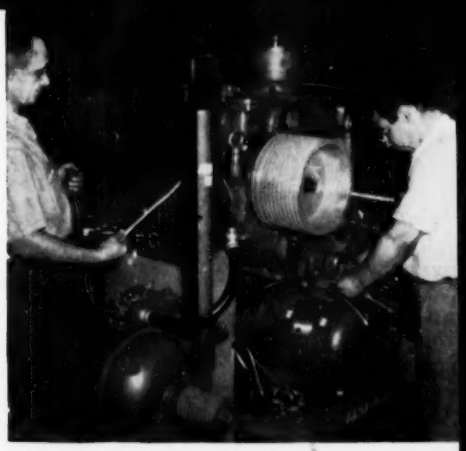
Our maintenance organization is headed by a superintendent assisted by three staff men and three foremen. Of the three staff assistants, one is responsible for all electrical alterations

WELDING, both electric arc and acetelyne, is performed by maintenance men on jigs, fixtures and special equipment. Improved methods and equipment make this an important operation.

Round-the-clock manufacturing schedule at Warner & Swasey's Cleveland plant depends upon an integrated maintenance organization with the responsibility and *authority to insist on* proper selection, installation, use and care of all electrical equipment. Qualified electricians, modern tools, routine check lists, and adequate inventory of parts all contribute to the efficient operation of this assignment.

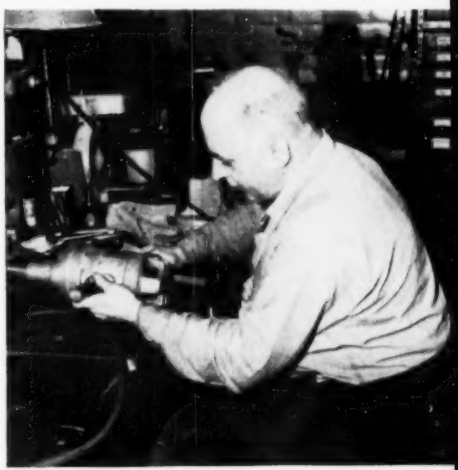
and additions, power layouts and—for large jobs where additional manpower is required—for contracts with outside service or construction organizations. The second staff man is responsible for lubrication, coolants for machines, and slings. The third assistant keeps cost records and is purchasing agent for electrical maintenance and construction equipment and materials. These three assistants report directly to the maintenance superintendent, as do the three shift foremen.

Since the plant operates continuously, there is no advantage to be gained by scheduling routine construction and maintenance jobs for weekends or night-time, therefore most of this work is completed on the first shift. During this period our maintenance foreman is aided by five assistants (for electrical maintenance, electrical construction, crane repair, machine maintenance and power house maintenance) and five crew foremen (for machine, building, office equipment, lubrication and porter assignments). Twelve electricians work on electrical construction, 4 men are assigned to cranes (of which we have 135 jib, hoist and tramrail units), while electrical maintenance calls for 12 gen-



CONTROL PANELS, relays, transformers and terminal blocks are assembled and installed by the electrical department.

RELAYS, transformers and other devices related to motor control are assembled and wired by plant electricians.



SMALL POWER TOOLS are kept in continuous working order through scheduled inspection, lubrication, replacement of worn parts or repair to damaged components.

TROUBLE CALLS require a full analysis to pinpoint the source of failure. Here the load is checked on a machine where the overload heater units have just tripped out.

INSTRUMENTS used by the maintenance department include power factor, volt and ammeters, Meggers, high-voltage testers and various clamp-on devices.

DRIVE MOTORS for machines in the production department receive regular inspection and renovation. Only the rewinding is done by outside motor shops.

eral electricians and 6 specialists who take care of elevator motors, overhead doors, electric trucks, tow motors, time clocks, the p.a. system, all lighting equipment, electrical equipment in the cafeteria kitchen, air conditioning units and the like. It is of interest to note that 16 crane operators are also classed as maintenance personnel, since we reason that keeping this equipment in good condition depends as much upon proper use as upon regular inspections and adjustments.

Training and Inspection Program

It may be safely stated that "any plan of organization will produce gratifying results if carried out by qualified personnel and, conversely, the best plan may fail if it is followed by men without adequate abilities". While this is not intended to belittle maintenance organization, it does stress the value of qualified foremen and electricians. That does not mean that all persons engaged in electrical maintenance need have college degrees, but there is strong evidence that maximum benefits from the use of electrical equipment will not be realized until the caliber of the men operating and maintaining this equipment is such that they have more than a smattering of electrical fundamentals.

In selecting applicants for our department, we require that they have a formal education at least through high school and, in addition, we desire those who have had extra training through the mediums of special night courses, apprenticeships in the building trades, or practical experience in the field. When these men are first added to our roster we start them on the work benches performing minor jobs under the supervision of more experienced men. They are then placed in the stockroom so as to become acquainted with the equipment and materials kept on hand. After observing and analyzing their aptitudes at testing, using meters, making repairs and performing routine assignments, we then place them in either our construction or maintenance crews. Here they work on increasingly important jobs under the guidance of older men until their proficiencies qualify them for independent operations.

Even our older employees are required to use check-off lists to make sure that routine inspections are complete. As a double check, foremen then scan these work sheets and also make spot checks on the work as well. When any maintenance job is not finished by the end of a shift, this fact is noted in our department log book and it is completed on the following shift. Also, when a job of particular interest or importance is either pending or in progress, it is likewise noted in the log and checked by the foreman of the following watch.

Incentives for Constructive Suggestions

Employees are encouraged to make suggestions whenever they think that a change in routine or in the design of some piece of equipment will result in a production saving, an improved product, added safety, greater convenience to workers or higher morale. As an incentive, these suggestions are recognized in our company magazine, "Turret Topics," and the person making the suggestion is rewarded with a cash bonus amounting to 20% of the savings resulting from the suggestion during the following year. The bonus is paid upon adoption of the idea but, if estimated savings prove lower than savings actually realized, the bonus is augmented at a later date. Where suggestions do not result in money savings but do result in intangible benefits such as improved safety or convenience, these benefits are also given a dollar evaluation. These bonuses have run as high as $1500 to a single man, and total awards average well over $5000 a year. Suggestions have included such diverse ideas as changing the size of screw holes in pushbutton gaskets, placing oil drain holes in the bed of a weaving machine, keeping an extra set of operating sheets in storage outside the plant as a safeguard against possible fire damage, and revising the conduit layout for an automatic chip conveyor unit. Bonuses for these particular ideas ranged between $70 and $48.

Maintenance is Thorough and Continuous

Most maintenance routines are continuous, with men assigned to various jobs working in different areas each day, constantly repeating the cycle. For example; the four men assigned to the maintenance of the 135 cranes (capacities of which range from 10-ton to 500-pounds) complete the cycle of the plant once a week. During the first part of each month, emphasis is placed upon preventive measures, scheduling planned shut-downs when it becomes advisable. However, during the latter part of each month when crane activity and shipping operations are heaviest, emphasis is placed upon continued

service, that is, avoiding shut-downs except for emergency repairs. Even then, repairs are made during lunch hours to minimize the down time. Another procedure whereby maintenance down-time is lessened is to perform these services whenever a production slow-down or stoppage is anticipated due to such interrupting factors as parts shortage, etc.

Inspection and maintenance routines are designed for thoroughness, in the case of cranes directing attention to sheave blocks, hoist cables, slings, hooks, controllers, electric brakes, trolley wires, feed rails, clamps, greasing and changes of oil. Cables are condemned whenever three breaks per foot are observed in the 19-strand assemblies, and hooks undergo regularly scheduled heat treatment to relieve the stresses induced by the heavy loads normally handled.

Maintenance of lighting fixtures is another continuous-cycle process, with men working in pairs to achieve greatest team-work and efficiency. In general, reflectors are cleaned by hand (using a solution of 1 part Penetone detergent to 10 parts water) while eggcrate louvers for the fluorescent units are cleaned in the continuous-belt cafeteria kitchen dishwashing machine that automatically applies the detergent, washes the louvers under pressurized water jets, rinses and dries the units. Experience with this method of cleaning shows that it is a practical time-saving expedient, but care must be taken to run the louvers through the machine faster than normal dish speed so that enamel surfaces are not cracked or spalled off due to the high steam temperatures.

The recent installation in the office area of Westinghouse 4-lamp louvered fixtures on 10-foot centers and at heights of 12 feet raised footcandle intensities at desk-top levels from 30- to 75-fc, and a contemplated slimline installation in the drafting rooms should provide a similar intensity for working surfaces there as well. At present, drafting room intensities are 55-fc immediately after units are cleaned; dropping to 45-fc just prior to the following cleaning. This cleaning interval at present is six months although it is being shortened to four months in the near future. Lighting sources in the plant are varied; including fluorescent units in offices, incandescent luminaires in high bays in the manufacturing areas, and mercury vapor for areas devoted to small unit assembly and turret lathe production.

Distribution Features

Primary service at 11-kv is stepped to an intermediate level of 4160-volts for rotary converters, then to 240 for plant distribution and machine operation. Power for lighting is obtained through dry-type transformers that deliver 115/230-volts 3-wire, and this current is stepped up to 440-volts for the testing of assembled machines coming through the production department. Plant demand at the incoming 11-kv level is approximately 2900-kva.

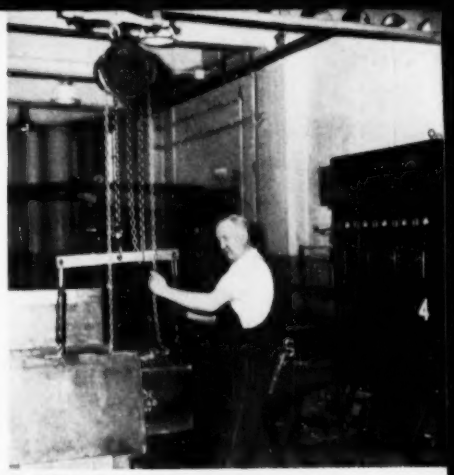
To prevent the overloading of separate feeders, obtain optimum voltage regulation and balance the phase loading, a survey is now in progress whereby the load connected through each panel and to each feeder phase is being recorded. In this connection, each panel switch is being numbered to coincide with the number of the machine or equipment it controls and, in the event that a machine is shifted or removed, the panel switch is renumbered accordingly.

Distribution is mainly via rigid steel conduit, busduct, trolley duct, floor troughs and square wireways.

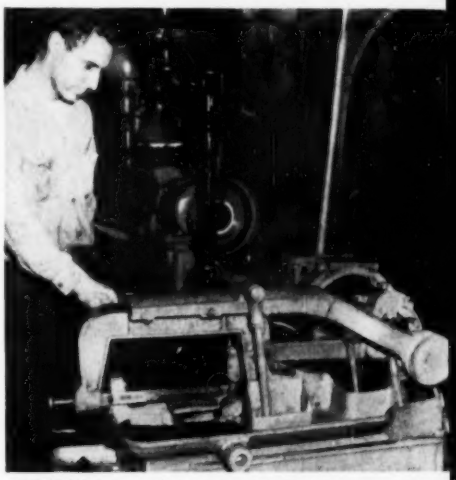
To maintain this system, our men are provided with such instruments as Meggers, lightmeters, power factor-, volt- and ammeters, high pots and clamp-on units. They are also provided with such power tools as sanders, impact wrenches, drills, buffers and polishers. Light welding and brazing is facilitated by portable gas tanks.

All tools and motors are repaired by our maintenance men, who recondition or replace armatures, fields, gears, bearings, shafts and keyways. Only when rewinding is necessary are motors sent outside to local motor repair shops.

We believe that, although many different maintenance programs are in existence in various industrial plants, the important consideration is not so much what type of program is followed but, rather, how conscientiously and thoroughly that program is followed by competent men. We appreciate that a good preventive maintenance program costs money and constitutes a tangible expense, while losses incurred through lack of maintenance can rarely be totaled as a lump sum. However, in spite of this evident maintenance charge, we believe that it is soundly justified by more efficient and reliable work by employees who know that the vital-to-production equipment they are using is as close to trouble-free operation as it is possible for maintenance personnel to keep it.



BATTERIES for industrial materials-handling trucks are replaced every 4 or 6 hours, depending on the truck's use. Recharging station and chain hoists facilitate this change.



CONDUIT for electrical installations in the plant is pre-cut on motorized hack-saws in the maintenance shop. Planned work schedules keep production down-time at a minimum.

MAINTENANCE SUPERVISOR and shift maintenance foremen discuss all maintenance problems and solutions. Work is then coordinated with other operations within the plant.

TRENCH for cable should be adequate in depth and width for trouble-free performance. This tractor plow is digging a trench 24 inches deep by 15 inches wide through both dry and wet areas.

Need for proper splices and installation, and for reliable measures against lightning, moisture, and mechanical damage are outlined and discussed.

By Robert C. Graham

Chief Engineer
Rome Cable Corporation
Rome, N. Y.

MINIMIZING FAILURES In Airport Lighting Cables

IN AIRPORT lighting work, as in so many other jobs, the quality of final result depends in large measure on the quality of the job of installation.

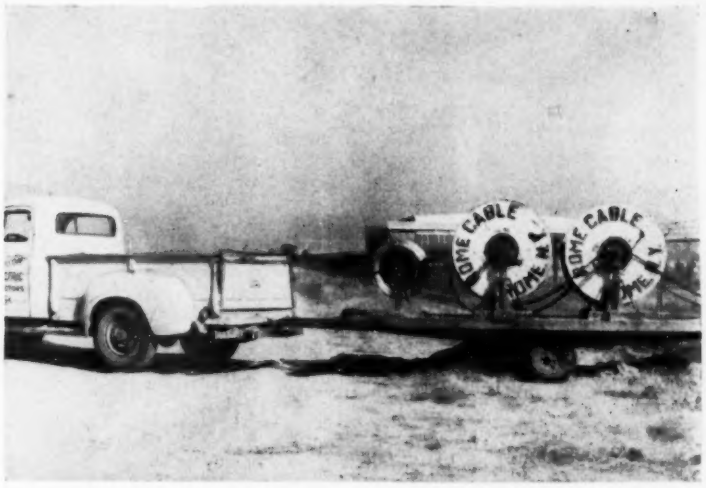
Even with the best cable and other materials, every splice, repair, and terminal must perform as well as the cable itself, or the installation may be faulty. The four principal causes of trouble in underground cable installations and their relative frequencies are approximately as follows:

(1) Improper splices and installation	50%
(2) Mechanical damage during or after installation	30%
(3) Lightning	10%
(4) Moisture	8%
(5) Other causes	2%

The major problem, therefore, is seen to resolve itself around the method of splicing and the skill and workmanship of the splicer. This factor is of utmost importance. Electric utilities employ only experienced and competent cable splicers, and this practice should be recognized in airport wiring as well.

Another practice that might be copied in airport wiring is to test each splice thoroughly before it is placed

MOBILE MIXER is used to provide a cable bedding of 3 inches of clean sand on the bottom of the trench.



CABLE REELS set up on trailer simplifies pulling of cable into ducts and speeds installation. Thompson Electric Co. used this trailer on the new Salt Lake City airport.

in operation. This can best be accomplished by insulation resistance measurements, and preferably in addition a high-voltage dc proof test equal to three times the operating voltage of the cable. Both of these tests can be made with portable equipment that is readily available for such purposes.

The use of molded-on plug or terminal type of installation, as described in CAA Specification L-118, and used by the U. S. Air Force, virtually eliminates all serious splicing problems. Even with this type of connection, however, it is desirable in permanent installations to add a few layers of good synthetic tape over the outer section of the area where the male and female units join.

The type of splice described in CAA Specification L-108, using a splice box filled with a bitumastic material, is cumbersome and obsolete. A preferred procedure is referred to in CAA-L-118, consisting of a joint made with a sleeve connector, and with the splice built up by several layers of a good splicing tape and protected with a layer or two of Neoprene tape. Good splices also may be made more simply with a single thermoplastic tape which requires no additional coverings. Complete splicing kits, including directions, are commercially available for these jobs, and this also is true of shielded or lead-sheathed cables with which extra precaution is necessary in shielding the splice or wiping a lead sleeve.

The mechanical damage that causes 30% of cable failures generally can be attributed to carelessness or ignorance. Care on the part of all the workmen on the installation can help to reduce this hazard immeasurably. There are good reasons for the specifications regarding depth and width of trench, protection at road crossings, and other installation features, and those specifications should be scrupulously followed. One element that is important, and that frequently is overlooked, is the back-filling of the trench. Care should be taken to avoid jamming of heavy or sharp rocks against the cable, as damage caused in that manner can always be a source of trouble on direct earth-buried cable. Permanent, visible marking of the underground cable route will help to avoid future accidents.

Lightning Hazards

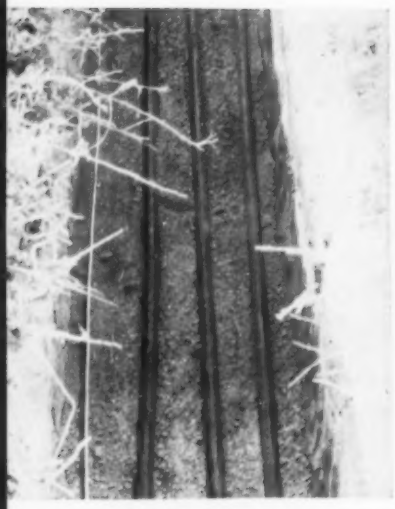
Lightning is one of the hazards commonly described as "acts of God" and over which it might seem we can exercise little or no control. Nevertheless, careful attention to this factor in affected areas will pay real rewards.

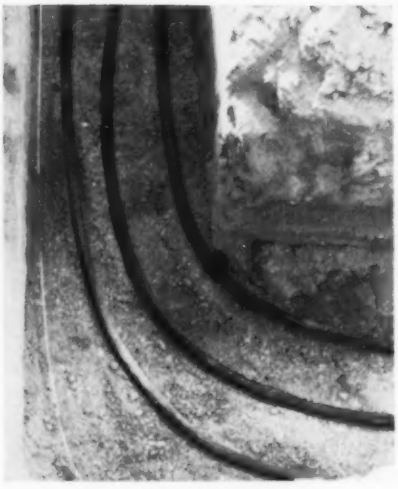
The mechanics of the damaging effects of lightning on underground cable are complex. A direct hit will, of course, cause destruction regardless of any protective measures that may have been taken. However, more frequent trouble is caused by the induced or secondary effects from lightning or switching surges. Abrupt changes in the surge impedance of the cable circuit will, under an impulse, set up reflected waves. Such "standing" waves have high amplitude, and may be reflected several times before dissipation. This gives rise to a brief, but tremendous, over-voltage or impulse condition which may electrically break down or rupture the cable dielectric. Actual failure may not be detected until several weeks later, when water ultimately penetrates the damaged area and causes a low resistance short to ground. Carbonization of the surface, or "spiral" burning, in a conventional unshielded Neoprene-sheathed cable, generally are accepted as clues that lightning has been the damaging force.

The best way to provide lightning protection, then, is to incorporate means to insure a continuous and uniformly low impedance cable circuit to reduce the possibility of reflected waves. A non-shielded cable buried directly in the ground may pass through dry, very wet, or only moderately wet areas. Each of these different ground conditions means a change in impedance, and a possible source of trouble.

Use of metallic conduit is one way to reduce this hazard by providing a uniform impedance circuit. Use of shielded or lead-sheathed cable is another answer to the problem. Most of the high voltage power cable at Idlewild Airport, for instance, incorporates shielding which provides lightning protection, but more especially provides protection against surface discharge effects. Power cables at Boston's Logan Airport are lead-sheathed.

There is an easy and fairly satisfactory solution for direct buried non-shielded cable already installed, or to be installed. The procedure consists simply of installing a No. 8 AWG. bare copper wire in the same trench





THREE CABLES and a counterpoise wire (bare copper) for lightning protection are uniformly spaced over sand bedding in straight-away trench (left) and around a bend (right). Unshielded cables should be well separated throughout entire circuit to avoid sheath discharge between cables.

ANOTHER LAYER of clean sand 3 inches deep is poured over cables after they are laid in trench to provide complete protection from above as well as below.

with the cable—preferably three to 6 inches from the cable throughout its entire length. This "counterpoise" technique provides good lightning protection by establishing a uniform impedance, but it does not, of course, give any of the other advantages of total shielding.

Another recommendation to reduce lightning effects is to select a cable insulation having a high impulse strength. For example, CAA Type B insulation generally will have an appreciably higher resistance to impulses than Type A insulation. A high-quality ozone-resistant oil-base insulating compound (CAA Type B) consistently has good impulse strength.

Here again, splices can be an added source of trouble, for a poor splice may break down under lightning effects that leave the cable itself undamaged.

An underground cable connected directly to an overhead line is the most vulnerable kind of installation, so far as lightning is concerned. In such cases shielding of the cable is virtually mandatory if failure is to be avoided. The use of arrestors and/or isolating transformers also is suggested as a further preventive measure.

Cable buried directly in the earth is regarded as a "submarine" type of installation, since the ground may be alternately wet and dry. Therefore, unless an impervious lead sheath is used, the cable insulation should be one which has good electrical stability after long-time immersion in water. Until quite recently, the accepted underground cable designed involved the so-called "Parkway" construction, which consisted of rubber insulation, a lead sheath, steel tape armor, and a layer or two of impregnated jute. Such a cable, when properly installed, has provided an almost perfect operating record.

However, first cost of such cable is high, and splicing, terminating, and other installation operations are difficult and expensive. Furthermore, the need for cable of that type in most installations is questionable.

Introduction of the underground non-metallic sheathed cable several years ago provided a significant improvement in underground series lighting cable. Since the war such a cable design has consisted generally of a high-grade moisture-resistant rubber insulation, with an overall Neoprene sheath. In this cable the Neoprene sheath provides the necessary mechanical protection, as well as a barrier against sunlight and earth chemicals.

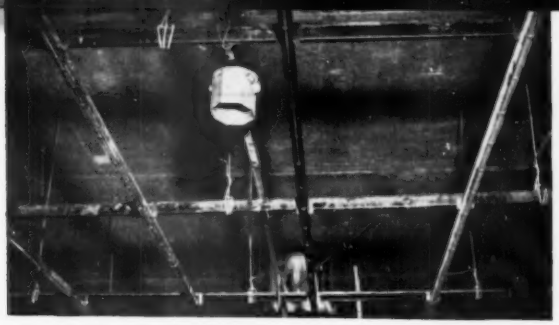
The rubber insulation of such a cable must provide both electrical insulating value, and moisture resistance, so it is important that the compound be a good one. Fortunately, such compounds are available today, either as a combination moisture- and heat-resistant grade or, preferably, a high-grade ozone-resistant insulation. Such a cable can be buried directly in the ground, is simple to splice and terminate, and has an excellent operating history. In fact, statistical operating records indicate that such a cable design has as low a failure rate as any other type. This type of cable construction has been approved and recommended by CAA for all underground wiring of airports.

Specifically, this cable consists of a copper conductor, 10/64 in. insulation, and a 4/64 in. Neoprene sheath. The more economical Type A, which now is limited to 3000 volts, utilizes a moisture-resistant performance grade rubber insulation, whereas Type B, which has been approved for all voltages, has an ozone-resistant insulation. At least two other types of cables are being used in airport installations. One of those has a metallic shielding tape between the insulation and the sheath, and the other has a lead sheath in place of the Neoprene. Both of these latter cable types are more expensive than the conventional unshielded CAA designs, and all of them are satisfactory for most types of installations.

The latest CAA cable specifications provide for the first time a moisture-resistant requirement for cable insulation.

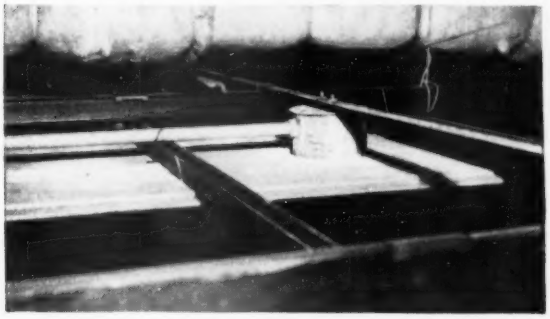
It has been found that a good ozone-resistant insulation (CAA Type B) generally will give better moisture resistance than the CAA Type A insulation, although the latter probably is adequate for most conditions. The overall Neoprene sheath provides little, if any, long-time protection against water. Here it must be emphasized again—an improper splice can cause failure if water is present. Water slowly, but surely, searches out splice imperfections, therefore—make the best possible splice the first time.

Soil bacteria, chemicals, termites, and rodents are among the other minor causes of underground cable troubles. Burial at the recommended depth usually will appreciably reduce bacterial attack.

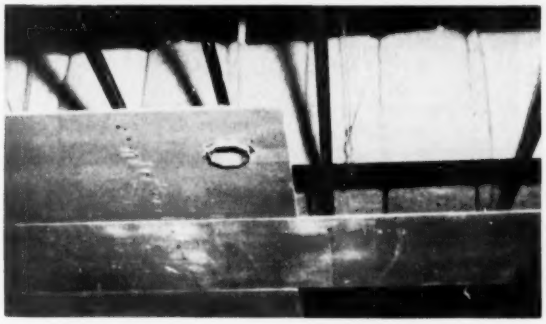


PRE-ASSEMBLED OUTLETS on channel support rest on the suspended ceiling grid. Note box connectors already in place.

DEEP CONCRETE RING permits quick installation of EMT ties and home runs even where space is limited.



NO OFFSETS were necessary to make conduit connection to deep box. Note outlet support fastened to main grid channel.



OUTLET PROJECTS below composition ceiling board; will be flush with acoustic tile to be installed later.

Concrete boxes simplify

Suspended Ceiling Outlet Installation

. . . by eliminating conduit offsets. C. A. Langlais Co. men bench-assembled outlets on rolled channel for lighting system at California State Motor Vehicle Headquarters.

A STUTE field engineering by Charles A. Langlais Company personnel led to a time-saving, pre-assembly scheme for mounting suspended ceiling outlets for the fluorescent lighting installation at the new California State Motor Vehicle Headquarters building in Sacramento. After careful study of the ceiling grid construction, Langlais branch manager E. M. Robinson and job superintendent C. A. Svec decided that deep concrete rings for outlet boxes would speed up the installation considerably. A few pertinent measurements and rough sketches provided all the confirmation they needed. The original plan to use conventional boxes was discarded and the concrete rings were substituted.

Specifically, the 3½-inch deep concrete ring with cover and fixture stud did this:

1. Eliminated all vertical-plane offsets in EMT connections at the outlet and permitted use of straight raceway sections.

2. Brought the bottom of the outlet flush with the finished acoustic tile ceiling and provided more wiring space for fixture connections.

3. Opened the door to bench pre-assembly of outlet groups and quick installation on the ceiling grid.

Bench assembly consisted of mounting the concrete rings and fixture supporting bolts to sections of ¼-inch rolled steel channel at predetermined spacings (eight feet for outlets). Box knockouts were removed and the necessary EMT connectors installed. It took more than one channel section to span the room width, so channel ends to be joined were identified with colored paint to assure proper positioning of outlets during installation. Joints were made with bolted splicing plates.

The pre-fabricated assemblies were distributed at specified points along the floor, then placed in the open space between the slab and ceiling. The outlet channel rested on the main supporting members of the suspended ceiling grid. Bench marks cut into the channel ends were aligned by plumb bob with reference points chalked on the concrete floor to assure perfect alignment of outlets (and fixture supports) in all directions. Following alignment, channel sections were secured to ceiling grid by a wire wrap.

Installation of EMT raceways between outlets was now a simple operation. Precut lengths of straight tubing were placed in position, the box connectors backed-off and the final connection made. Only in a few cases of panel home runs were offsets necessary. All these were of the horizontal-plane type.

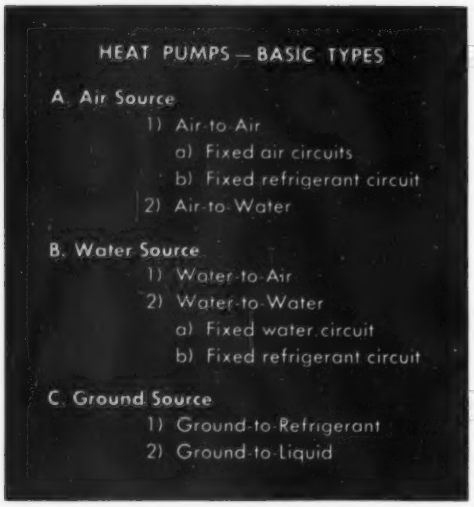


FIG. 1. Heat pumps vary in type according to the media involved in the transfer of heat.

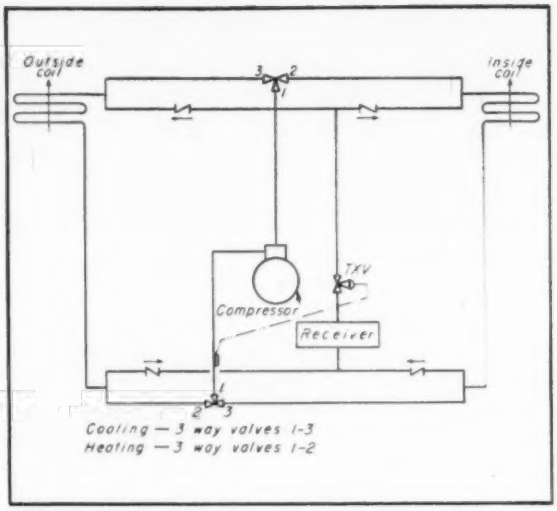


FIG. 2. Air-to-air heat pump system with fixed air circuits.

What The Electrical Contractor Should Know About . . . .

THE HEAT PUMP

Widespread application of the heat pump is still on the horizon; but these year-round all electric air conditioning units show much promise. Here's a roundup of heat pump operating fundamentals which the electrical contractor should know.

By I. B. Faigen and D. W. Hoppock
Carrier Corporation

MUCH has been said, is being said and will continue to be said about electric powered refrigeration equipment which has come to be known as the "Heat Pump". Although practical application to date is limited, the promise which heat pumps show at this stage of the game is reason enough for electrical contractors to look into the operating details of the equipment and to get some idea of what typical installations might involve.

A domestic refrigerator and a unit air conditioner are both heat pumps in a sense, but they pump heat in only one direction. A refrigerator pumps heat out of the insulated box into the kitchen through the condenser on the back or bottom. An air cooled room air conditioner pumps heat out of the room and rejects it to the outdoors through the condenser on the outside.

What has come to be called a "heat pump" today is really a two way, or reversible, air conditioner. To follow the room air conditioner illustration, it is as if the unit were physically turned end to end for winter operation, so that it would take heat from the outdoor air and pump it into the room. However, instead of physically reversing the machine, the "heat pump" is so arranged that either the refrigerant circuit or the air circuit is reversed by refrigerant switching valves or air dampers.

Fig. 1 lists, in outline form, the heat pump types usually encountered. Heat pumps are classified as to type by the source of heat for winter heating. These classifications are:

(1) *Air Source:* where heat is taken from outdoor air to heat the space.
(2) *Water Source:* where heat is taken from well water or lake water; and
(3) *Ground Source:* where heat is removed from the earth by buried pipes.

In addition to heat being taken from these three sources in winter, heat is rejected to them in summer.

1. AIR SOURCE

In an air-to-air heat pump, heat is extracted from outdoor air, elevated to a higher temperature level by the refrigeration system, and put into the air which heats the space. Heat flows from outdoor air to refrigerant to inside air.

There are two variations of air-to-air heat pumps. The first is a fixed air circuit—outdoor air is pulled through the outside coil and rejected, while inside air is recirculated through the inside coil. In this system, the refrigerant is diverted through different paths for summer and winter. The term "reverse cycle", commonly used not long ago to describe this system, is a misnomer: the refrigerant cycle is not truly reversed.

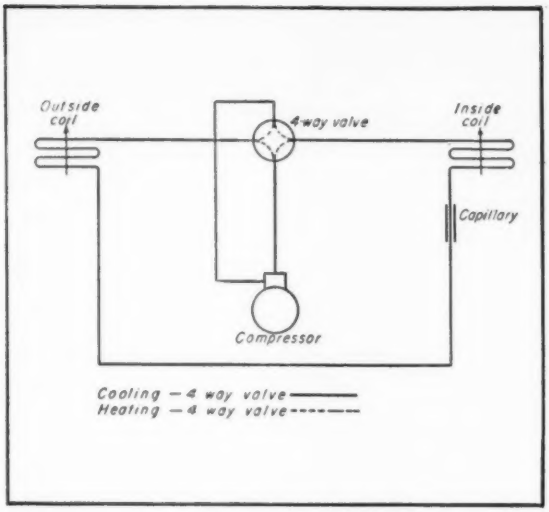


FIG. 3. Air-to-air cycle using a Tipton 4-way valve.

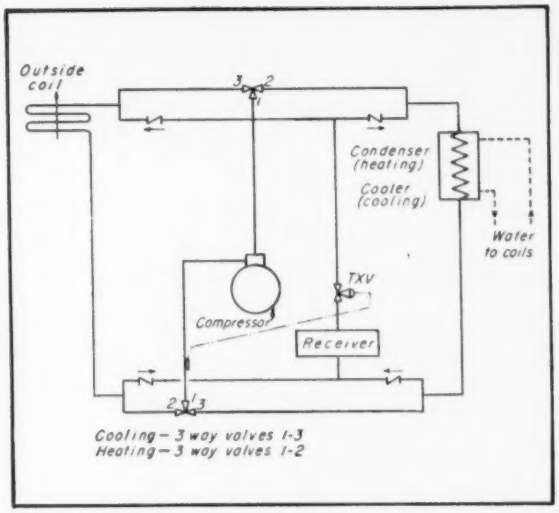


FIG. 4. Air-to-water system of refrigerant and water piping.

The second variation of the air-to-air heat pump is a fixed refrigerant circuit system. The paths of the two air streams are changed from season to season by dampers, while each component of the refrigerant cycle performs the same function year 'round.

In an air-to-water heat pump, heat is extracted from outdoor air and put into a circulating water system, after being elevated in temperature level by the refrigeration system. Heat flows from outdoor air to refrigerant to water to inside air. The air-to-water system would be more applicable to an applied equipment job where more than one internal zone had to be heated. The zoning is more easily accomplished by a circulating hot water system.

2. WATER SOURCE

In a water-to-air system, heat is taken from well water or lake water, elevated in temperature level, and placed directly into the conditioned air system.

In a water-to-water system, heat is taken from a water source and rejected into a circulating water system. Again, this type of system is more applicable to an applied equipment job than to a piece of unitary equipment.

Just as in the air-to-air systems, there are two variations of the water-to-water system. In one, the water circuit is fixed and the refrigerant circuit is changed by the season. In the more common system, the refrigerant circuit is fixed, and the water circuit is switched.

3. GROUND SOURCES

Some of the big news in heat pumps a few years back centered on a new type which extracts heat from the earth via imbedded pipes, carrying either refrigerant or anti-freeze liquid. In the first of these types the flow of heat is from ground to refrigerant to inside air. In the second, the flow of heat is from ground to liquid to refrigerant to air. In either case, a circulating water system could be interposed between refrigerant and inside air. Both types are in use, with air as the more common medium.

Performance

Basically, a heat pump must elevate heat energy from a low, practically useless level to a higher, more useful level. The cost of accomplishing this is the cost of the power that drives the refrigeration system—fans, compressors, and in water system, pumps. By dividing the heat output by the power expended —in similar units of measurement—we get a number which is called the Coefficient of Performance. The higher this number, the better the heat pump.

Consider the air source heat pump. As the outside air temperature drops, the suction temperature at the compressor drops, in order for flow of heat from the outdoor air into refrigerant to continue. Accompanying this action are a higher horsepower requirement and a reduced capacity, resulting in a lower Coefficient of Performance.

At the same time that the lower outdoor air temperature is causing a decrease in the heat output, it is also causing a greater requirement for heat inside. When more heat is needed, less is obtainable, and at higher unit cost. This, in effect, limits the usefulness of the air source heat pump to extremely mild winter climates.

Tests have recently been run using an air source heat pump farther north, with electric strip heaters to boost the heat pump at lower temperatures. Besides this added cost, however, there are other problems to be overcome. Most important of these is the problem of defrosting the outside coil. Present defrosting methods are such that a drop in inside temperature almost always occurs during defrosting.

At present, both costs and performance problems make the air source heat pump impractical, except in the far South, where the performance problems are somewhat alleviated by warmer winter temperatures.

The water source heat pump draws heat from well water, or perhaps lake water, where quantity is a dependable item and temperature is constant. The fact that the temperature of the source is constant erases most of the performance problems of the air source heat pump. This also makes the unit cost of heat for a given locality a rather constant item. In addition, it makes it possible to design, for a specific area, a heat pump with proper balance between heating and cooling capacities.

In addition to its fewer mechanical problems, a better Coefficient of Performance and better operating cost, the water source heat pump has potential use throughout a wider geographical area than does the air source heat pump.

It is difficult to make definite conclusions about the ground source heat pump. So little is known about coils and about ground conditions that the

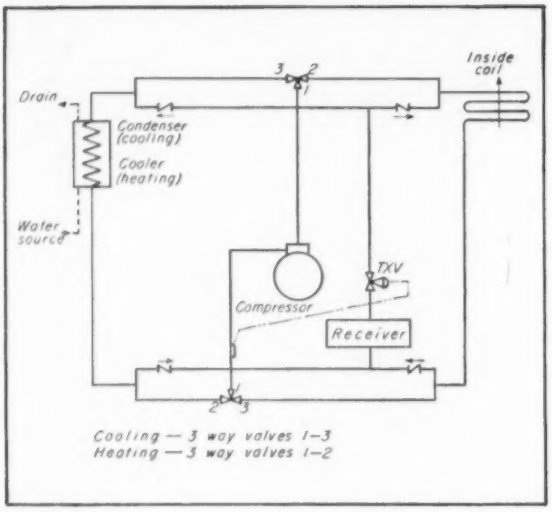


FIG. 5. Water-to-air heat pump, refrigerant and water piping.

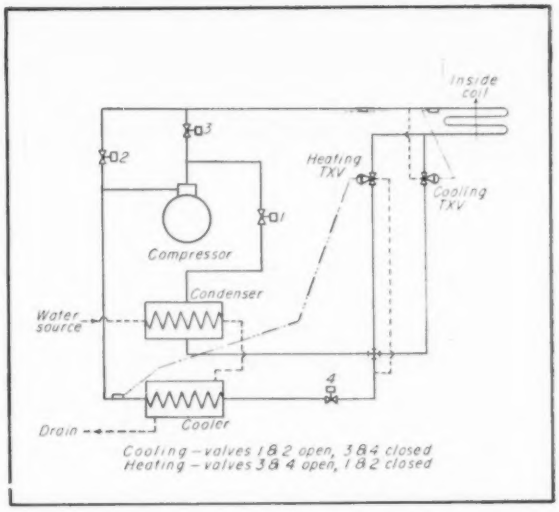


FIG. 6. A variation of the basic water-to-air heat pump cycle.

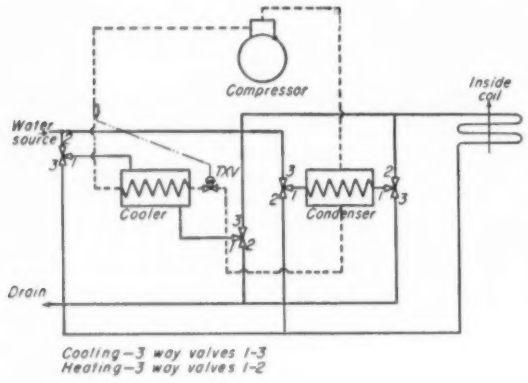


FIG. 7. Basic water-to-water system, fixed refrigerant circuit.

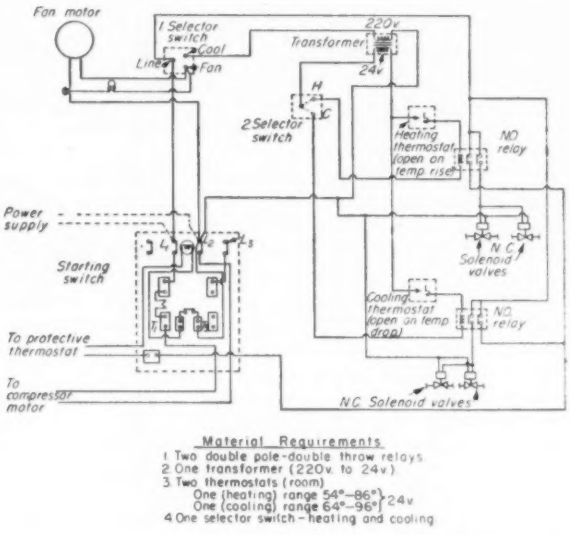


FIG. 8. Schematic wiring and control diagram of a self-contained reverse cycle air conditioning unit indicates maintenance, servicing requirements and extent of installation.

use of a ground source heat pump requires much detailed engineering. Furthermore, the costs of ground source heat pumps are very much higher than the cost of conventional year 'round air conditioning—as high as $500 per installed horsepower. Most of the present activity centers around applied jobs in the St. Louis area, where experience has revealed enough information about the earth there to make these jobs satisfactory.

Piping Systems

Some typical heat pump piping systems are shown in the accompanying illustrations. These schematic diagrams are basic for each type of heat pump system.

Fig. 2 shows the refrigerant piping for an air-to-air heat pump with fixed air circuits. On the cooling cycle, the 3-way valves are in the position 1-3; on the heating cycle, in the position 1-2. This diagram shows only one method of piping-up a heat pump system. There are many variations. For example, each 3-way valve shown can be replaced by two solenoid valves. The check valves can also be replaced by solenoid valves. There are many, many different piping diagrams for heat pump systems.

Figure 3 shows an air-to-air heat pump cycle using a Tipton 4-way valve, as applied to a room air conditioner. The Tipton valve is one patented device—there are other 4-way valves. The path during the cooling cycle is shown as a solid line, while the path during the heating cycle is shown as a dotted line.

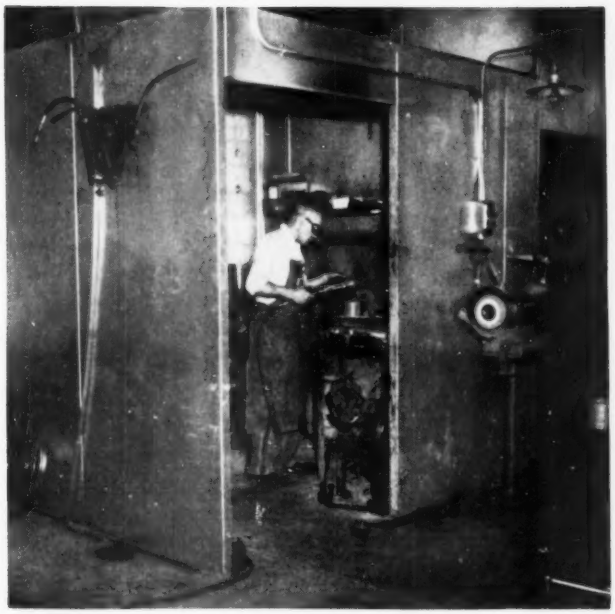
Figure 4 shows the refrigerant piping, and a little of the water piping, for an air-to-water heat pump. The refrigerant lines are solid, and the water lines dotted. On the cooling cycle, the 3-way valves are in the position 1-3; on the heating cycle, in the position 1-2. The shell-and-coil vessel on the right is a condenser for the heating cycle, and a water chiller for the cooling cycle.

Figure 5 shows the refrigerant piping, and some of the water piping, for a water-to-air heat pump. The refrigerant lines are solid, the water lines dotted. The shell-and-coil vessel shown on the left acts as a condenser for the cooling cycle, and as a water chiller for the heating cycle.

Typical Operation

Figure 6 shows a variation of the water-to-air heat pump. The solid lines

(Continued on page 184)



SHOP BOOTH isolates welding operations in an enclosure equipped with the necessary materials and accessories.

MATERIAL STALLS on inside wall hold a variety of rod, bar, flat, angle and channel stock.

Compact Shop Welding Booth

. . . saves time and expense in electrical construction and repair operations of T. L. Rosenberg Co., Oakland, California.

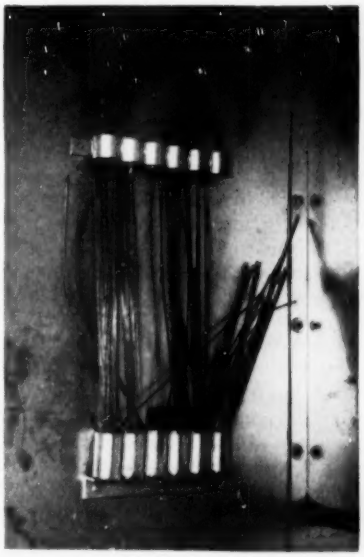
THERE is always a certain amount of welding work (either oxyacetylene or electric) involved in electrical construction and equipment repair operations. Whether a firm has its own welding facilities or farms this work out to a job shop depends upon the quantity of welding required over a period of time. The decision to do one or the other usually is dictated by the economics and convenience involved.

Management of the T. L. Rosenberg Company, combination electrical construction and equipment repair firm in Oakland, California, chose the former method and installed a compact shop welding booth. With these facilities shop mechanics can prefabricate material and equipment supports in small or large quantities; can salvage cracked motor frames, bases and end bells; can do the many repair operations associated with welding.

Biggest advantage, in addition to cost reduction, is the convenience of having the equipment immediately available when needed. Considerable time normally involved in pick-up or delivery of farmed-out work is saved.

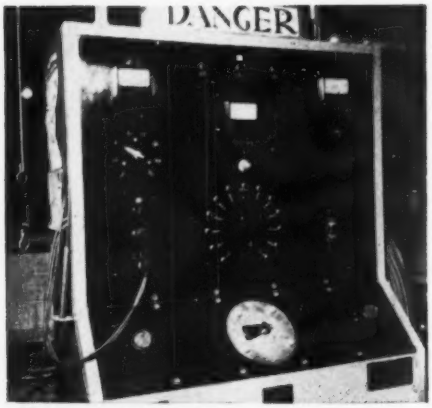
The nine-foot square booth has sheet-steel walls nine feet high and is open at the top. Interior design points to efficient operation. All materials and accessories are racked in place and are within easy reach of the mechanic. Ten "stalls" on the left wall, built with conduit sections, hold a variety of different sized bolt rod, flat iron, angle-iron and steel channels normally used in fabrication of equipment supports. Special shelves hold torch nozzles. And immediately above the work table, less than an arm's length away, is a welding rod rack fashioned from angle-iron and short sections of 2-inch conduit.

With this system, the major portion of all welding operations can be isolated from the main shop area. To management, this booth is a valuable piece of shop equipment which has more than paid for itself.

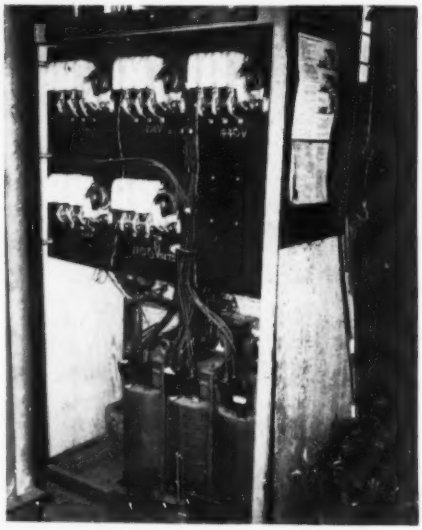


WELDING ROD is racked on wall above work bench. Mechanic lifts proper rod out of conduit cup at base and slides it down out of retaining sleeves at top.

COMPACT DEAD-FRONT PANEL provides multiple test facilities in a minimum of floor space, embodies flexible circuiting and maximum safety features.



SWITCH AND METER arrangement permits simple operation. Ammeter with tap switch and phase jacks is on left. Hi-pot, 13-step tap switch and pushbutton is in center. DC equipment at right.



REAR VIEW OF panel showing transformers and main contactors for multiple-voltage tests. Control circuits are hidden by contactor board.

Console Type

Multiple-Test Panel

provides maximum facilities in minimum space at Johnson-Turner Electric Repair and Engineering Co., in Windsor, Ontario

PRACTICALLY all the test facilities required in the motor repair department of the Johnson-Turner Electric Repair and Engineering Co., Ltd., Windsor, Ontario, Canada, are combined in a dead-front panel which covers about nine square feet of floor space. With the equipment and circuits contained therein, mechanics can make running tests on 60-cycle, 25-cycle or direct current motors. Operating voltages are 110, 220, 440 and 550. Hi-pot test voltages vary from 250 volts at the bottom to 10,000 volts at the top of a 13-step range. All test leads are of the jack-plug type. There are no live parts with which operating personnel can come in contact.

All switches, contactors, transformers and meter circuits are enclosed in a console-type cabinet 6-ft. 8-inches high and measuring 48 inches by 27½ inches at the base. All sides, except meter panel and tilted rheostat panel, are plywood mounted to a steel angle-iron and channel frame.

Unique among the panel features is the flexibility of the metering and test circuits. A single 5-ampere ammeter is used to indicate all test alternating currents. An eight position 150-ampere tap switch connected to primary taps on the meter current transformer provides seven meter scales ranging from 1.5 to 150. Meter leads from the tap switch and c.t. primary terminate in a pistol-grip plug equipped with two rectangular phosphor-bronze contacts separated by a piece of fiber insulation. Behind the panel, each phase conductor has a set of spring-compressed contacts mounted at a rectangular jack opening. When the meter plug is pushed into the jack, these spring contacts are spread apart and the meter is inserted in the phase conductor. With this arrangement, the meter—at any one of its seven ranges—can be inserted in any phase leg to indicate motor running currents.

The 13-step tap switch for the high-voltage test is encircled by a ring of colored pilot lights—red being the color for the standard 2,000 volt test. As a safety precaution this transformer is energized by a pushbutton under the tap-switch knob. When the mechanic's finger is off the button, the high voltage is off. A warning buzzer is also added to the circuit.

PAYS FOR ITSELF IN ONE JOB!

HYPRESS

Cost comparisons by Busch Bros., Inc., electrical contractors for New Jersey's new Linwood Park Housing project, showed savings on Hydent connectors, (against cast connectors) more than paid for the Hypress.* On future jobs, savings will amount to more than 80% of former connector cost. Even against the most economical type of bolted connector, savings will average 40%–50%.

Write for Burndy Hydent Catalog Y53 and find out how you can connect with savings.

*Itemized cost comparison on request.

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NORWALK, CONNECT. FACTORIES: New York, California, Toronto **TORONTO, CANADA**
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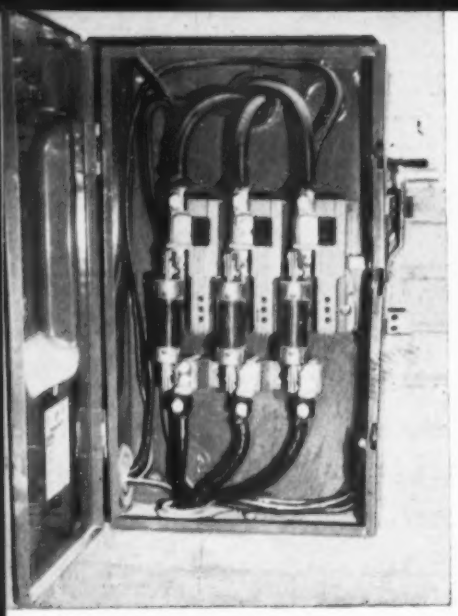
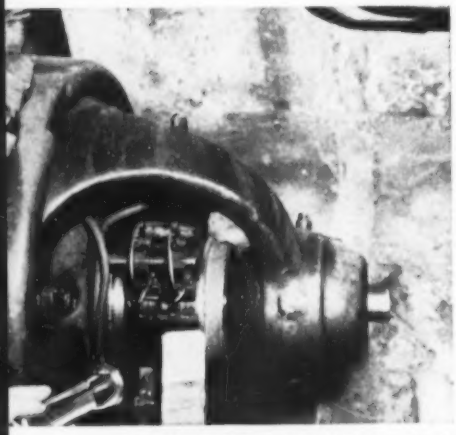


SAFETY FIRST. Always open safety switch before commencing work.

MOTOR BEARING should be maintained properly lubricated. Open bearing oil-filling cap; check oil level; lubricate. Check overflow cap.

BRUSH LENGTH, condition of commutator, free movement of brush in holder and brush contact must be checked regularly.



COMMUTATOR CLEANING should be made at times of routine servicing, using heavy canvas mounted on a wooden stick.

Practical Elevator Maintenance

Successful maintenance of any electric elevator system depends upon sound planning of an integrated program for inspection and servicing. Preventive procedures must be established to assure long life and safe and continuous operation of the related electrical and mechanical components

By Walter J. Prise
Chief Engineer
The Maintenance Company
New York, N. Y.

PRACTICAL maintenance of electric elevators includes routine procedures for effective upkeep of the chain of electrical and mechanical parts involved. Procedures must account for regular inspection and servicing of motors, electrical control equipment, brakes, gears, guide rails, sheaves and ropes.

Of course, the maintenance operation for electric elevators must be organized and scheduled in accordance with the special features of elevator operating requirements, the amount of equipment and the number of maintenance personnel. In such organization, however, elevator maintenance follows the same general rules which govern any industrial maintenance program.

Servicing

Servicing of electric elevators involves visual inspection of all electrical and mechanical components of the elevator system, and on-the-spot repair and adjustment when necessary. Experience has shown that a minimum procedure for overall elevator servicing should be established in accordance with the following outline:

1. Motors—check for

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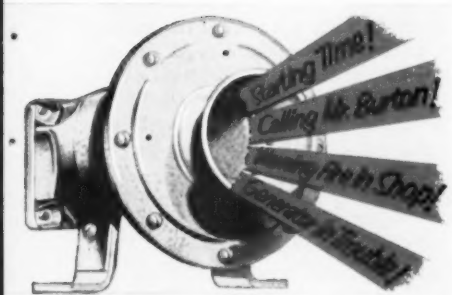

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Read in this book, how Benjamin is best qualified . . . through over a half-century's experience and a most advanced sound laboratory . . . to advise you on your signalling requirements—and why Benjamin signals are unique—vibrant—dominating over all competing noises.

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ELEVATOR BRAKES are of various designs. Knowledge of all types is essential. Here, inspector points to brake adjustment.

AIR GAP between brake shoe and drum should be checked for proper clearance. Binding or slippage must be eliminated by adjustment.

ADJUSTMENT BOLTS on the side of this solenoid operated brake are taken up to eliminate slippage and secure proper braking action.

a. Sparking, opens and shorts on commutator.
b. High mica and presence of foreign matter on commutator.
c. Proper length, spring tension and free movement of brushes in holders.
d. Overheating, loose fit and lubrication of bearings.

When necessary, brushes should be replaced if worn more than 65% of their normal length or if they may get too short before the next inspection. The commutator should be wiped with heavy canvas, and brushholders, cleaned.

2. Control equipment—check for
a. Faulty movement of parts.
b. Worn or broken parts.
c. Defective contactors, springs and shunts.
d. Abnormal arcing action.
e. Presence of foreign matter—fluids, dirt, grease, chemical, etc. —on operating parts.

Defective or suspicious parts should be replaced immediately; faulty operation should be investigated until conditions of actual or approaching trouble have been removed.

3. Brakes—check for
a. Dirty or worn linings.
b. Excessive play in brake pins.
c. Dangerous slippage.
d. Improper lubrication of hinge pins.
e. Faulty operation of solenoid or contacts.
f. Deviation from manufacturer's instructions for proper brake adjustments.

As conditions demand, replace worn brake pins, hinge pins or other defective parts. Brake linings should be cleaned, and excessive wear should be reported to the office. Any dangerous slippage in the brake should be reported immediately to the proper authority. When servicing solenoids, care must be taken to distinguish between the operating requirements of ac and dc types.

4. In worm gear units used for speed reduction of the motor drive—
a. Check oil level.
b. Check operating temperature to determine presence of overheating.
c. Check packing to prevent leakage.
d. Check loose motion adjustment.

5. Guide rails and associated parts—check for

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INSULATING VARNISH DIGEST

Internal Curing Type Of Varnish Results in Complete Drying and Integrated Windings

Conductors are held in a compact homogeneous mass, free from wet, tacky interiors when impregnated with any of Irvington's internal curing varnishes.

These varnishes assure deep penetration and thorough curing, while at the same time permitting the use of fast, money-saving baking schedules. Range of types available permits selection to meet specific requirements such as: high oil and heat resistance; complete oilproofness; exceptional mechanical strength; long life at high temperatures; extreme resistance to chemical attack.

Motor repair shops dip stators and armatures in Irvington's internal curing varnishes for deep penetration, fast curing throughout and strong conductor bonding

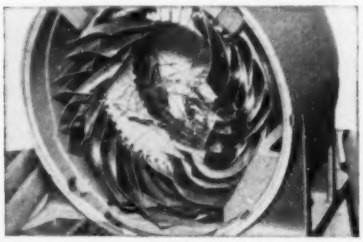
Special Binder Used in Slot Insulation

A newly developed binder for bonding a fibre backing to flexible varnished insulation makes it possible for Irvington to produce a slot insulation with mechanical strength needed to withstand forming to fit any type of motor slot. Used in Irvington's IRV-O-SLOT cell insulation, this binder has the "give" necessary to prevent rupture of the varnish film during the forming operation. The binder does not harden with age nor ooze out under the effects of heat. Both shelf life and service life are greatly increased.

Motor Repair Shops Face Growing Demand For Rewinds with Class "H" Insulation

Design Trend to Use of High-Temperature Materials Points Way to Need for Same Insulation in Repairs

The reduction in frame sizes and the increased overload capacity made possible by motors designed for the use of Class "H" insulation have led to the increased use of materials of this type by electrical manufacturers. More and more of these motors, in which the insulation is capable of withstanding continuous operation at 175° C., are now in use throughout industry. While an outstanding characteristic of these motors is their ability to withstand high ambient temperatures or heavy overloads, it is natural that their windings may fail under conditions of severe abuse. Motor repair shops and industrial maintenance departments will therefore be faced with an increasing need to rewind these motors with the same Class "H" insulations with which they were originally wound.

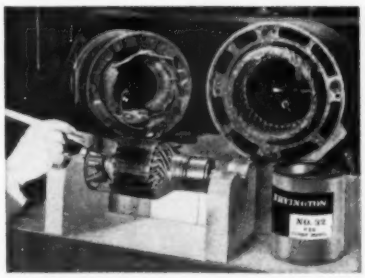


For long life at 175° C., phase coils and slot cells of this motor are insulated with Irvington Class "H" Silicone Varnished Fiberglas

Oilproof Finish Coats Improve Rewind Jobs

For extra protection of motor windings against the harmful effects of oil, grease, moisture and chemicals, a finishing coat of quick-drying enamel can be easily applied by a dip, spray or brush-on operation to windings already impregnated with Irvington Insulating Varnishes.

Irvington Red Enamel No. 32 is commonly used where fast drying time, consistent with good protection, is desired; No. 30 Red is preferred when service conditions are exceptionally severe.



Irvington Red Enamels are easily brushed on, give added protection against oil, grease, dust

Types of Class "H" Insulation

Class "H" insulation consists of inorganic materials, such as Fiberglas* or asbestos, treated with silicones or other high-temperature materials. The Irvington Class "H" insulations most commonly used in motor manufacture, and hence most commonly required in Class "H" rewinds, include:

Silicone Varnished Fiberglas, Silicone Coated Asbestos, Silicone Saturated Asbestos, Silicone Rubber Coated Fiberglas, Teflon** Coated Fiberglas, Silastic ®*** Tape, Silicone Rubber Coated Fiberglas Tubing, Silicone Coated Novabestos****.

All of these Irvington Class "H" insulating materials retain their excellent physical, chemical and dielectric properties under continuous operation at elevated temperatures.

In addition, the wide range of Irvington materials permits the rewind of Class "H" motors so that they will meet other severe operating requirements. For example, Silicone Rubber Coated Fiberglas and Silastic® Tape remain flexible at temperatures as low as —70° F. and, Silicone Varnished Fiberglas resists moisture.

Corrosive Atmospheres

For applications where corrosive atmospheres are involved, Teflon Coated Fiberglas is commonly used. This insulation possesses an exceptional degree of chemical inertness, is low in water absorption, unaffected by outdoor weathering. Send for your free copy of Irvington's Class "H" Insulation booklet.

* ®Owens Corning Fiberglas Corp., ** ®du Pont de Nemours, *** ®Dow Corning Corporation, **** ®Raybestos-Manhattan, Inc.

(For further information, write the Sales Manager, Varnish Dept., Irvington Varnish & Insulator Co., 18 Argyle Terrace, Irvington, N. J.)

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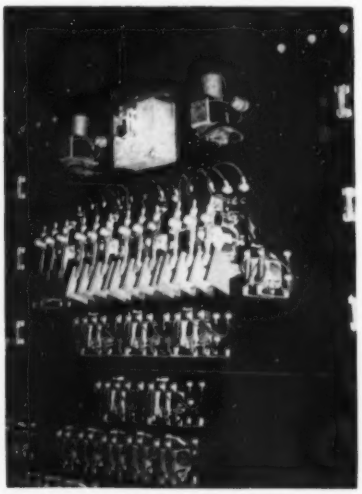
SHEAVE BEARING should be checked for proper lubrication and grease cup adjusted by one or two turns. Add oil or grease if necessary.



CONTROL BOARD (front) should be examined for free movement of parts and proper functioning of relays. Replace defective parts.

a. Improper clearance, lubrication and wear on guide rails and guide shoe gibs.
b. Excessive movement of roller guides, where used.
c. Faulty operation of elevator car safety.
d. Any indications of damaged parts.

Contact between guide shoe gibs and guide rails must be maintained firm and in accordance with any special instructions of the manufacturer. Rollers should travel freely and smoothly along rails. Any abnormal movement, rubbing or wear should be corrected immediately.

6. Interlocks and limit devices—check for
   a. Improper operation (by actuating the mechanism).
   b. Excessive or insufficient lubrication.
   c. Worn, broken or otherwise defective parts.

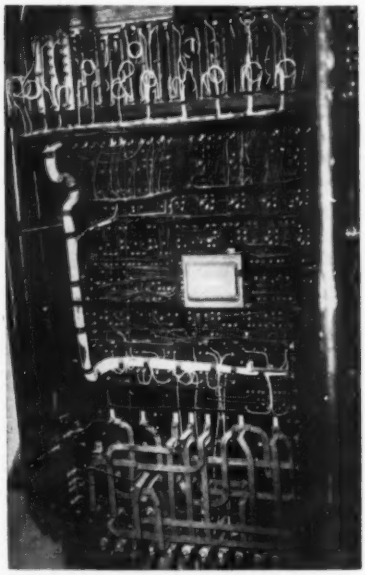
For effective servicing, the maintenance man should know the special operating features of each switch and interlock. Proper functioning of these devices should be ascertained carefully.

7. Sheaves—check for
   a. Wear and poor fit of rope in sheave grooves.
   b. Improper lubrication of sheave bearings.
   c. Worn or noisy sheave bearings.

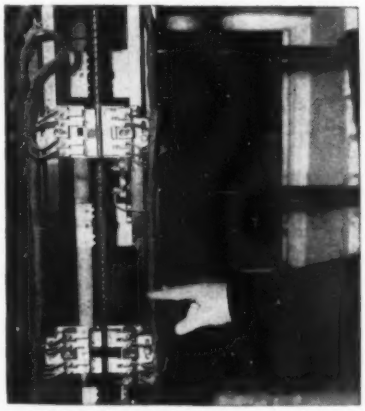
One of the surest indications of poor fit between wire rope and sheave grooves is unusual noise. Any defect in the sheave arrangement should be reported immediately.

8. Wire Ropes—check for
   a. Breaks in the stranding.
   b. Misalignment and abnormal tension.
   c. Improper lubrication (depending upon instructions of manufacturer).

Of course, major defects in elevator



COMPLEX WIRING on back of control board should be examined for defective insulation, broken wires and loose connections. Dirt and dust will interfere with action of resistors and deteriorate wires.



FLOOR SELECTORS are highly susceptible to troubles due to many moving and delicate parts. Careful inspection and prompt repair are necessary.

HOW CAN A *Friendly* MANUFACTURER HELP YOU IN YOUR BUSINESS?

We at Triangle have an old fashioned idea that what we and our distributors can *give* you—friendship, help, cooperation, is sometimes more important than the wire, cable or conduit we sell you.

That feeling is strengthened every time we get a letter saying, "You and your distributors sure helped us out of a jam" or "We can't help but tell you how much we appreciate your cooperation."

When you constantly get such comments, you know that a lot of people like you are profiting from doing business with Triangle. Perhaps you too will find that things run smoother when you do business with Triangle.

Here are some of the things our field men, in cooperation with a nation-wide network of top electrical distributors, give, every working day—and many a night!

- **Expert, friendly counsel on how to get the most and best wire, cable and conduit for your money.**
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- **An expediting service famed for its helpfulness. We're not supermen, but if it can be done, we'll do it.**
- **Printed material - calculators, wiring manuals and other literature useful to you many times during the year.**
- **A spirit of friendliness and helpfulness that will make you feel comfortable when dealing with Triangle.**

No matter who you are—contractor, engineer, maintenance man—no matter who you work for—utility, city, contracting firm, large industrial—

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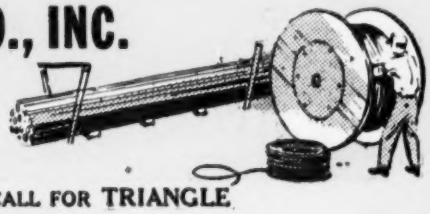

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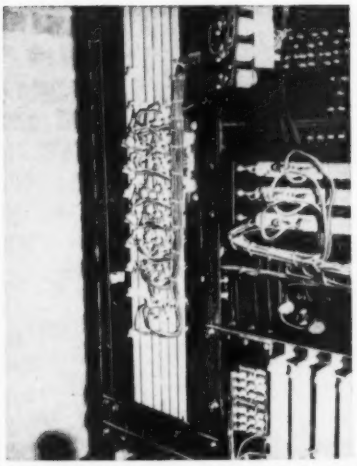
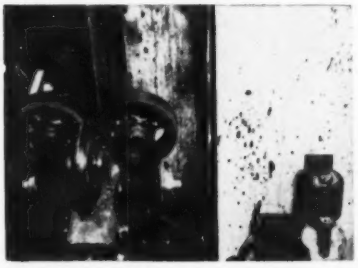
Work-Saver Pipe Tools



REAR VIEW of another control board shows wiring and components which must be checked. A different type of floor selector is shown on left.



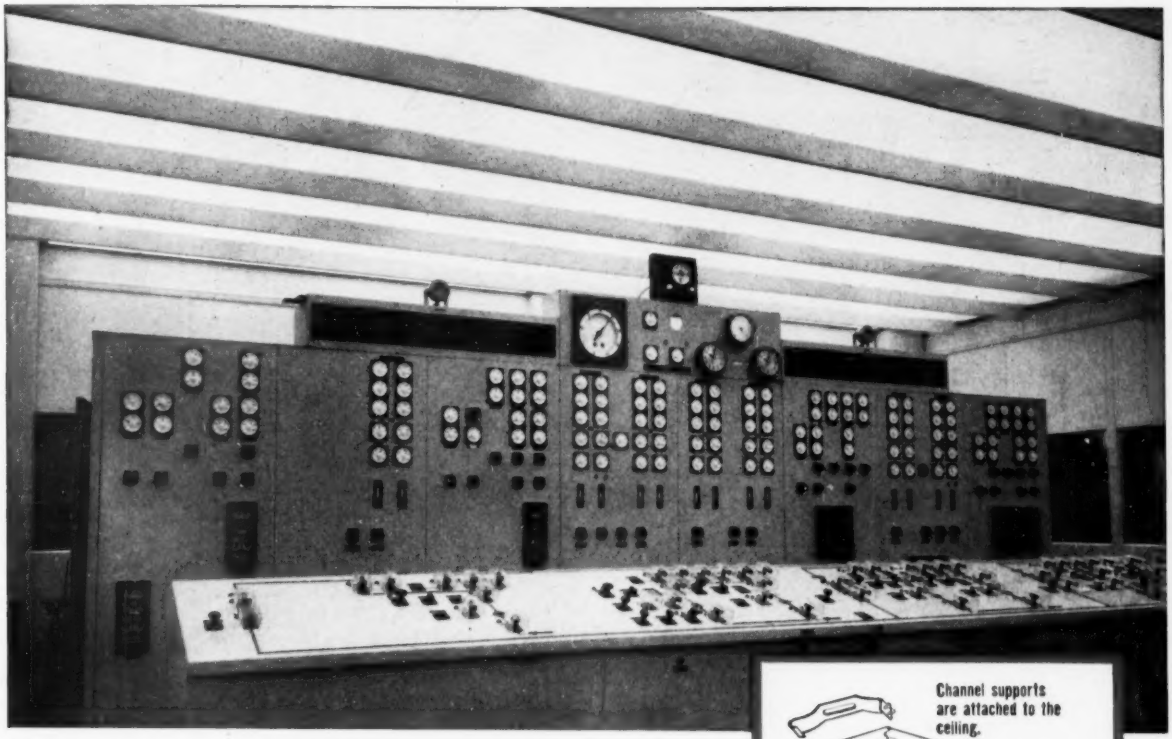
ELEVATOR RAILS and roller type guides must be checked for excessive movement. Rails must be clean, and rollers, lubricated and adjusted.

LIMIT SWITCHES must be examined for freedom of action (actuate the mechanisms manually). Here, cover is removed for inspection and adjustment.

ropes must be corrected immediately to eliminate serious hazard. One way to check for breaks in stranding is to wrap waste around an individual cable and slide it along the cable. The waste will snag and hook on broken strands indicating defect.

Scheduling

Although servicing is of prime importance in elevator maintenance, a carefully planned schedule is equally



New and Profitable Business for Electrical Contractors . . .

INSTALLING WAKEFIELD "THREE-WAY" CEILINGS...

1. With the Wakefield Ceiling, contractors are given an opportunity to sell and install entire ceilings instead of just fixtures.

2. The Wakefield luminous ceiling may include acoustical baffles and can be used as a diffuser for air conditioning, yet it is always installed in its entirety by an electrical contractor licensed by Wakefield.

3. The Wakefield Ceiling is an engineered, standardized "package" shipped to the job with simple installation steps clearly outlined.

4. Many Wakefield Ceiling installations have been made with labor costs running no more than 10% to 15% of total installed cost.

5. Qualified contractors are invited to become Wakefield-licensed installers. Wakefield will furnish a factory man for on-the-job training in the early stages. Write to The F. W. Wakefield Brass Company, Vermilion, Ohio.

Channel supports are attached to the ceiling.
Channels containing wiring, ballasts and lamp supports are then secured in place.
Baffle rods to support diffusers and baffles simply hook on lamp supports.
Leveling adjustment raises or lowers baffle rails.
Acoustical baffles fit on baffle rails. Plastic diffusers are quickly set in place.

THE F. W. *Wakefield* BRASS COMPANY
Vermilion, Ohio

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Extra dependable industrial motors
1 TO 250 HORSEPOWER (N.E.M.A. STANDARDS)
Extra large "free-flo" air channels.
Liberal size grease lubricated bearings.
One-piece cast iron frames.
Permanently aligned cast iron brackets.
Also a complete line of Direct Current motors and generators
ELECTRO DYNAMIC
DIVISION OF GENERAL DYNAMICS CORPORATION
BAYONNE, NEW JERSEY
HEART of the motor
3. Extra high-frequency testing of insulation between turns.
4. Extra care in fitting coils into stator.
The WINDING is the
1. Extra insulation in stator slots and between phases.
2. Extra impregnations and bakings of the wound stator.
QUALITY SINCE 1880
WRITE TODAY FOR NEW ILLUSTRATED CATALOGUE NO. 571

important. Inasmuch as some of the servicing checks are more important than others, the periods of inspection and servicing vary. A detailed schedule for inspection and servicing can be based on the following periodic plan: Every two weeks—

Check commutator, brushes and slip rings.
Check motor bearing's oil level.
Adjust grease cup on shaft of sheave for proper lubrication.
Add oil or grease if necessary.
Check controller operation.

ELEVATOR CABLES must be examined for breaks in the stranding over the full length of each cable. Major defects constitute serious hazard.

DOOR OPERATORS are of many types. All are complex mechanisms and linkages which must be actuated for checking, adjusted and lubricated.

SPECIAL TOOLS have proved extremely important in elevator maintenance work: (Left to right) Insulated screwdriver, thin bent-nose pliers, combination fuse puller and neon light tester, grip type pliers, adjustable ignition type pliers, door-opening keys, box wrench, reamer, circular snips, long nose oil can and small flask of cleaning fluid.

IF IT'S PARANITE IT'S the RIGHT Wire and Cable

PARAFLEX Non-Metallic Sheathed Cable lays flat. Won't squirm or twist. Clean to handle. Plainly marked.

PARASYN Type TW Thermoplastic Wire stands exposure too severe for rubber insulated wires. Smaller diameter.

PARA-USE Type "RR" Cable provides permanent underground installation from power line to meter, and for connecting several buildings. Meets requirements of CAA Specifications L-824 as Type A (on all applicable sizes).

HYDRO-THERM Building Wire combines in a single wire the heat-resistant qualities of Type RH and the moisture resistant qualities of Type RW.

URC Weatherproof Wire and Cable can be relied upon to meet severe climatic conditions. Both actual line and Weather-Ometer tests prove unusual ageing characteristics.

SERVICE ENTRANCE CABLE, Type SE Style U unarmoured and Type SE Style A armoured. There is also a Paranite Service Drop Cable, two conductor, Type SD.

DREADNAUGHT Heavy Duty Cable has lead-cured neoprene insulation. Flexible, durable, safe, long-lived. Cuts repairs and replacements. Delivers current continuously.

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Division of ESSEX WIRE CORPORATION
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EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 15 E. 26th ST., NEW YORK 10, N. Y.

ELECTRICAL WIRES AND CABLES *"BETTER THAN CODE REQUIRES"*

Cut installation holes faster

Only $49.50

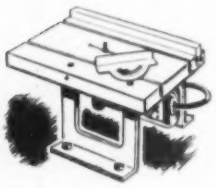
Complete with 5 different blades

with this NEW

Black & Decker UTILITY PORTABLE JIG SAW

Makes short work of cutting openings in walls for switch and outlet boxes.

Perfect for cutting holes in floors and walls for running conduit and service pipes.



Accessory table converts saw to Bench Model . . . only **$14.95**

Here's a new Black & Decker tool to help speed your installation work—the B&D Utility Portable Jig Saw! It's perfect for cutting holes in floors and walls to run service pipe and conduit . . . it makes short work of cutting openings in partitions and walls for installing switch and outlet boxes! And it will make any cut—straight or irregular—in sheet metal, wood and wallboards of all types! Needs no "entrance hole" when making pocket cuts in wood or wallboard—the sabre blade cuts its own! And the best part of all is that the price on this new tool, complete with 5 blades to cut most every material, is considerably less than you expect for this quality. See and try the Black & Decker Utility Jig Saw today at your favorite Black & Decker outlet! For free catalog, write to: THE BLACK & DECKER MFG. CO., Dept. 617, Towson 4, Maryland.

Black & Decker

UTILITY TOOLS — PORTABLE ELECTRIC TOOLS

Clean brakes and floor stops.
Adjust or renew brakes.
Check tension springs and holders.
Clean motor room.

Once a month—
Clean sheaves and shaft.
Clean rails.
On some motors, monthly inspection is sufficient. (Most ac motors).

Once every three months—
Check all cables.
Check car switch and contacts.
Clean top of the car.
Lubricate door locks and cams.
Check door operator selector tape and door check.
Check timers.
Examine elevator shafts.

Owing to the increasing complexity of modern electric elevator systems, many special problems exist in elevator maintenance work. Careful attention to special controls and other unusual features of any elevator system must be integrated in the inspection and servicing schedule. Servicing of automatic and operatorless elevators, for instance, must account for the equipment which distinguishes these machines from simpler ones. Depending upon the operation of any elevator, then, many special rules and maintenance techniques must be developed. Of course, any elevator maintenance program must take into consideration safety codes and regulations for elevator operation.

Although these rules are general and far from all-inclusive, they represent overall guidance for establishing a preventive elevator maintenance program. The actual details of servicing specific faults in elevator equipment are similar to repair methods with which every electrician should be familiar. Although these repair methods are beyond the scope of this article, a wealth of informative literature is available.

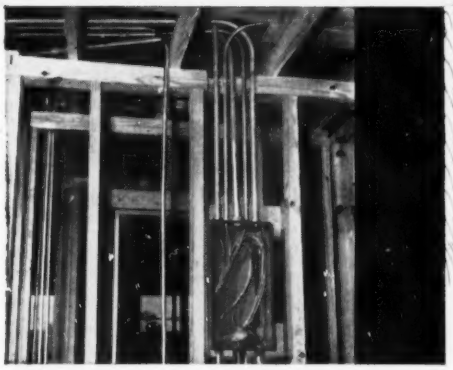
EXECUTIVE-SECRETARY of the Madison (Wis.) Mechanical Contractors Association, Edward R. Stege, coordinates the activities of three separate groups, the Madison Chapter, NECA, the Heating, Piping and Air Conditioning Contractors and the Madison Association of Master Plumbers.

Over 200,000 feet of

SPANG® EMT

thin wall conduit with the

SPANGLEAM finish installed in Miami Housing Project



The damp, salty atmosphere and year-around high temperatures of Southern Florida climate place high requirements on the type of EMT thin wall conduit used in construction of new homes and buildings.

For this reason, 205,000 feet of Spang's new EMT thin wall conduit with the SPANGLEAM finish was chosen for use in wiring the new 350-unit housing project at Miami, Florida . . . because the new SPANGLEAM finish, inside and out, assures high corrosion resistance and years of service life.

Specially finished inside with a protective coating of resinous lacquer compounded with Zirconium, SPANGLEAM provides easier wire pulling, assured grounding and corrosion resistance.

Spang top-quality EMT conduit is easy to cut, bend and install . . . it's cleaner, easier to handle, easier to maintain. Ask *any* electrical contractor . . . he'll tell you *why* SPANG EMT thin wall conduit is better!

Spang EMT with the SPANGLEAM finish is available *at no extra cost* immediately in a full range of sizes from ½ inch to 2 inches. See your distributor today—ask for SPANGLEAM.

Owner and General Contractor:
Ricmar Builders, Inc.

Architect:
Thomas J. Madden, Jr.

Electrical Contractor:
Tri-City Electric Company, Inc.

SPANG CONDUIT

SPANG-CHALFANT
Division of The National Supply Company
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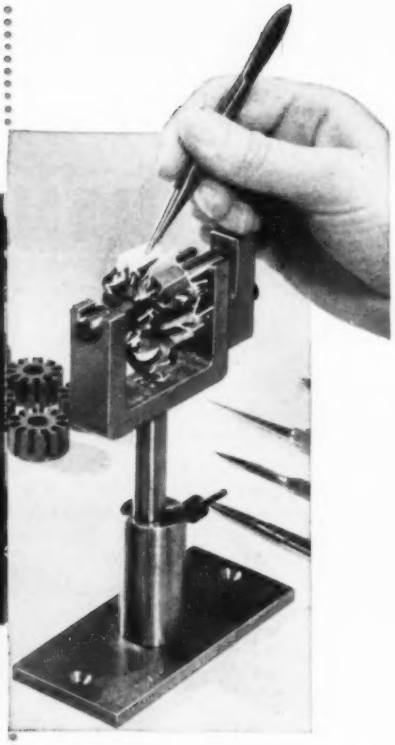
in Principal Cities

ONE EVERY TWENTY SECONDS! These tiny motor-like Autosyn Synchros are precision built by Eclipse-Pioneer at the rate of one every twenty seconds to meet the demands of modern aviation. These small "nerve centers" are used literally by the hundreds in vital indicating and control systems in today's aircraft.



Eclipse-Pioneer

DIVISION OF Bendix AVIATION CORPORATION

AUTOSYN® SYNCHRO STATORS ARE INSULATED WITH

NATVAR V.C.

Eclipse-Pioneer Division of Bendix Aviation, Teterboro, N. J., through development and manufacture of instruments and accessories, has been a major factor in the rapid expansion of the Aviation Industry. Although their production is now more than 5 times its pre-Korea level, this growth has been accomplished without sacrifice in the quality of its precision products.

To insulate stators of Autosyn Synchros, Eclipse-Pioneer specifies and uses Natvar varnished cambric because of its consistently good electrical and physical properties.

All Natvar flexible insulations are dependably uniform, no matter when or where purchased. They are immediately available either from your wholesaler's stock or direct from our own.

MIGHTY MITES! In spite of their size, Autosyn Synchros must operate with extreme reliability over a wide temperature range. Stators are being assembled in approximately 150 varieties at Eclipse-Pioneer, and strict adherence to engineering specifications is a must. They are insulated with strips of Natvar bias cut varnished cambric because of its uniformly high dielectric strength and flexibility.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubing and sleeving
- Varnished identification markers
- Lacquered tubing and sleeving
- Extruded plastic tubing and tape
- Extruded plastic identification markers

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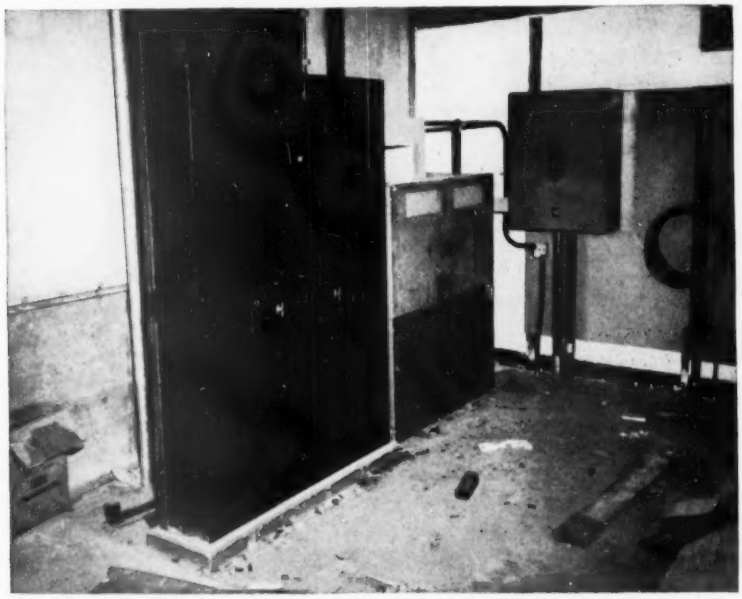
205 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

Practical Methods

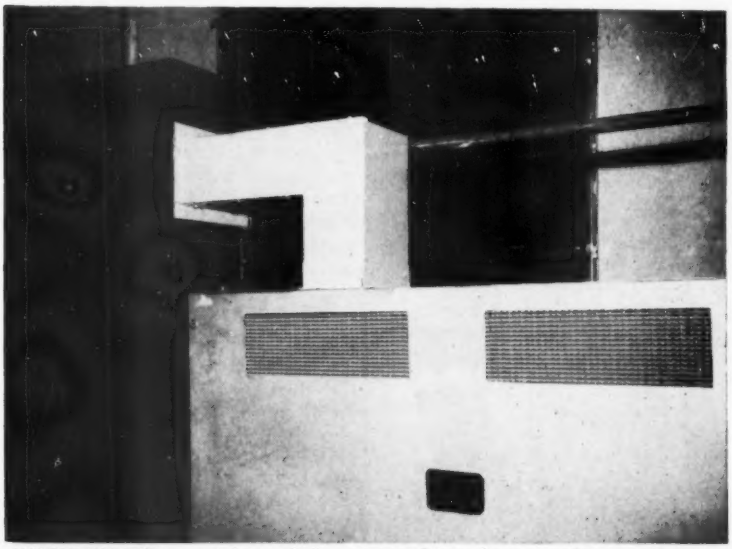
Enclosed Bus-Ties Solve Space Problem

WIRING

One of the many practical features of the electrical system design at the new ultra-modern headquarters building of the California Motor Vehicle Department at Sacramento (see page 69, Sept. 1952, EC&M) was the location of air-cooled substations in the penthouse supply fan rooms for the air conditioning system. This kept transformer hum out of the office areas and assured induced ventilation for the 300-kva, 3-phase, 480-v/120/208-volt air cooled transformer.



SPACE LIMITATIONS prevented in-line arrangement of distribution panel, transformer and main disconnect switch (on far wall) in this combination penthouse substation and air conditioning fan room. Enclosed bus bars connect transformer primary to main switch.



SHORT BUS TIE in metal trough leaves top of transformer enclosure and enters side of secondary distribution panel. Top panel entrance leaves gutter space free for branch circuit and feeder conductors.

In some cases, however, space limitations and structural conditions complicated the problem of connecting the main disconnect, on one wall, to the transformer and distribution panel located in front of an adjoining (right angle) wall. Branch manager Edward Robinson and general foreman Charles Svec of Charles A. Langlais Company, project electrical contractor, solved it by using short, enclosed bus-bar connections.

Connection between the 600-amp, 480-volt, 3-pole disconnect switch and the primary side of the transformer was made with three 2 in. by $\frac{1}{4}$ in. copper bus bars in a metal enclosure. A top-to-side tie between the transformer secondary and the taller distribution panel was made with four 4 in. by $\frac{1}{4}$ in. copper bus bars also enclosed in a protective metal trough.

Neoprene Jackets for Wiring In Wet Locations

WIRING

One of the roughest locations for electric wiring is found in the wet end of a paper mill where daily drenchings are a normal part of regularly washing down the equipment. In addition, the air itself is hot and steamy, floors are constantly wet and many areas are occasionally subjected to doses of chlorine, caustic soda and other chemicals used to digest and bleach the pulp.

The Ecusta Paper Corporation in North Carolina is no exception to these general conditions. There, during the process of bleaching their fine cigarette paper, the triple combination of moisture, heat and chemicals gangs up to give wire insulation a tough time, particularly in spots like that shown in the accompanying illustration: an expansion joint in the conduit system beneath a conveyor where wire is unprotected by raceways.

Type RW water-resistant wire jacketed with saturated braid was initially installed when the plant went up in '39, but braid deterioration and insulation breakdown dictated frequent repair and replacement until the company switched to neoprene-jacketed wire exclusively in all of its wet locations. This applied to new wiring as well as all replacements of the old braid-jacketed runs.

Neoprene-jacketed cables are now in use for all 5000-volt ac feeder circuits

In every detail the finest screw drivers that can be made. Handles are of tough black plastic, shock-proof and practically unbreakable. Comfortable *Octo-Grip* shaping prevents rolling and provides maximum turning power. Blades are of fine alloy steel with entire bar electrically heat treated under precision automatic control for greatest strength and toughness. Snap-on *Octo-Grip* screw drivers are available in a complete range of sizes and tips. Special purpose screw drivers for all industrial needs.

The complete Snap-on line includes 4,000 hand and bench tools for production and maintenance. Direct-to-industry service through factory branch warehouses in principal cities. Write for special industrial catalog and new 104-page general catalog.

SNAP-ON TOOLS CORPORATION

8048-E 28th Avenue, Kenosha, Wisconsin

*Snap-on is the trademark of Snap-on Tools Corporation.

HOSING DOWN these unprotected cable loops in a conduit expansion joint beneath a paper mill conveyor is a daily occurrence that formerly resulted in braid deterioration and insulation failure. The solution? Neoprene-jacketed cable.

throughout the plant, for most outdoor wiring both overhead and underground, and as power and control circuits at the 600-volt level in the bleach building, pulp mill, paper machine area and electrolytic cell room where chlorine for the bleaching process is produced from salt.

The wisdom of the switch is testified to by electrical maintenance supervisor Happ who states that, "Wiring failures due to jacket deterioration have disappeared completely and failures from causes other than jacket breakdown are practically nonexistent".

Wiring Raceways Expand Service In Offices

WIRING

Frame Electric Company of Pittsburgh, Pa., made good use of underfloor and surface electrical raceway to provide expanded telephone, light and power supply for the enlarged quarters of the Hospital Service Association of Pittsburgh.

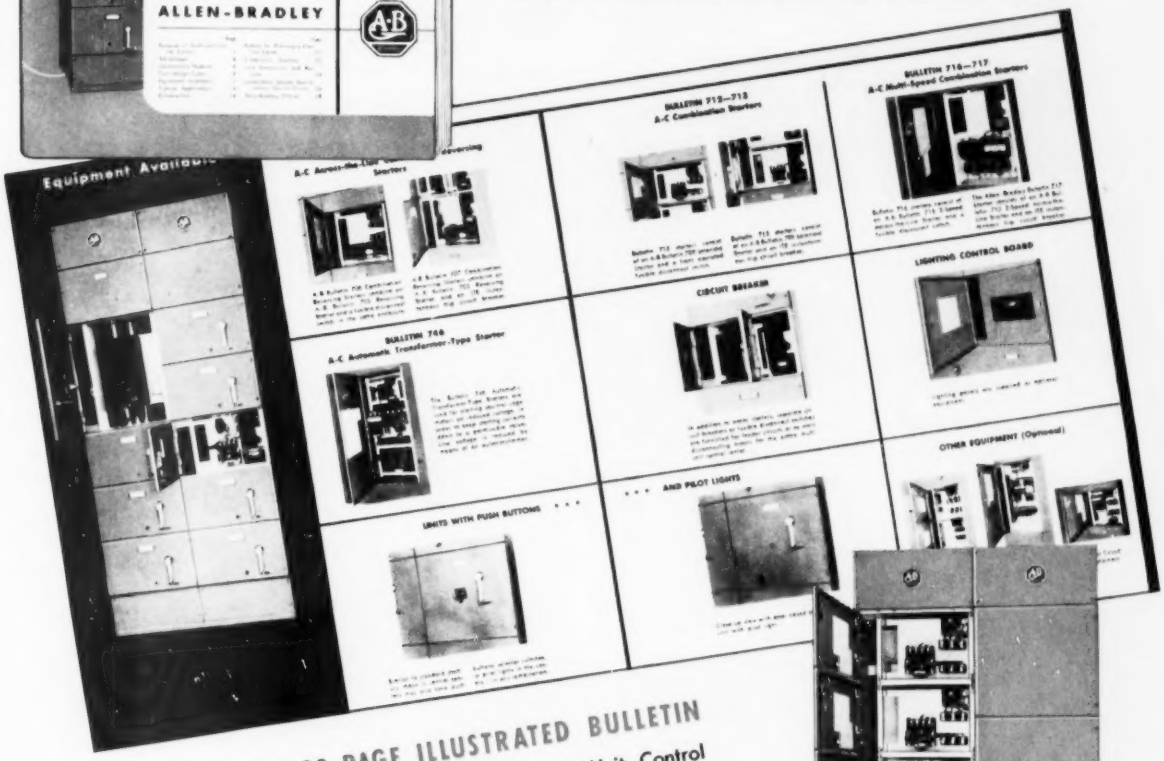
Due to the growth of The Blue Cross Plan for hospital care, and of The Blue Shield Plan for medical and surgical care, the Association was forced to seek larger quarters to serve its more than 1,700,000 subscribers in Western Pennsylvania. It secured the entire second floor of the Union Trust Building for this purpose, which had to be renovated and modernized, including the provision of new and expanded electrical service for the Association's various requirements.

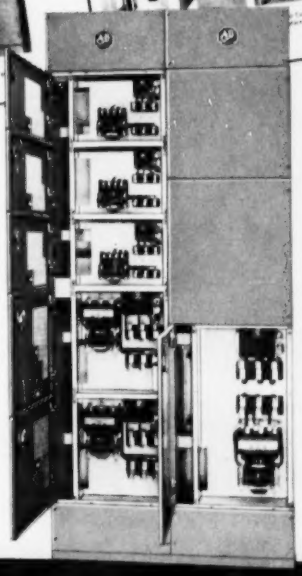
In the space occupied by the departmentalized clerical services of the Association, provision for adequate

Centralize

YOUR AUTOMATIC MOTOR CONTROLS FOR NEATER, SAFER INSTALLATIONS

There is a decided trend toward the use of Allen-Bradley Multi-Unit Control Centers. They concentrate all motor controls for a group of machines . . . or for your entire plant . . . in one spot. They make a compact installation that is safer and neater than scattered groups of individual controls. Inspection is centralized for easier and better maintenance.





SEND FOR THIS 28-PAGE ILLUSTRATED BULLETIN

This idea-packed catalog of Allen-Bradley Multi-Unit Control Centers has 58 illustrations and 18 diagrams of intriguing interest to plant engineers. It portrays how interchangeable panels of starters, reversing switches, circuit breakers, disconnect units, relays, and other control devices may be combined . . . just like building blocks . . . to provide precisely the control you need. Shows how easily changes can be made to satisfy revisions in plant layouts. Write for Bulletin 798, today.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

4-53-M

A-B Quality

ALLEN-BRADLEY

BULLETIN 798 MULTI-UNIT CONTROLS

QUALITY

MULTI-UNIT CONTROL PANELS

EASY TO ADD
EASY TO CHANGE
to meet
Plant Requirements

Available with
Manual Disconnect Units
or Circuit Breakers

Plug-in panels are ideal for continuous process industrie. which must be serviced while the bus is "hot." Fixed connection Multi-Unit Control Panels are popular for most industries.

CENTRALIZED MAINTENANCE

Centralized location of all motor controls promotes regular inspection, discourages tampering by unauthorized personnel, and does away with special mounting provisions so often needed for groups of starters. A-B Multi-Unit Control Centers can be installed more quickly than an equivalent number of separate starters, disconnect units, and accessories.

GREATER PLANT SAFETY

Not only do Allen-Bradley Multi-Unit Control Centers reduce the hazards of accidental personal contact with "live" switch gear . . . they also make possible the centralizing of motor controls in rooms far removed from hazardous gases, dusts, or fumes. They may even be installed out of doors in weatherproof cabinets. Send for Bulletin 798 for details.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

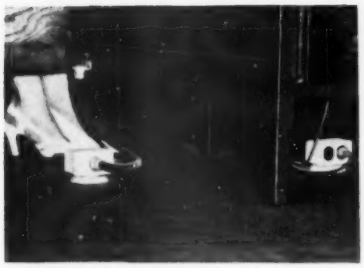
4-53-M

A-B Quality

ALLEN-BRADLEY

BULLETIN 798 MULTI-UNIT CONTROLS

QUALITY



TWO SERVICE FITTINGS fed from underfloor electrical raceways—one at right supplies power outlet for dictation machine; one under desk furnishes outlet for telephone service.

SURFACE RACEWAY (NEPCO 1700 Surfaceduct) is installed above the baseboard around the entire office area to supply power for various types of office machines.

DUPLEX RECEPTACLES in surface raceway furnish single-phase power take-off for punch machines in accounting offices.

telephone, light and power supply was assured through the installation of approximately 2,000 feet of Nepcoduct underfloor raceway. This system was laid in six long, double runs, with cross-runs installed in accordance with office floor plans.

In the accounting department area power is provided for the operation of 12 accounting and tabulating machines, two sorters, and four duplicating punch machines through runs of No. 1700 Surfaceduct, while in an-

The Features You Asked for:

the NEW Super Safe IDEAL Voltage Tester

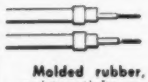
Thousands of Electrical Men Told Us What They Wanted — We Included Every Major Feature — No Other Tester Offers So Many Advantages for Easier, Safer Use:

NO OTHER TESTER HAS ALL THESE:

Handier center mount for prod makes testing easier

Prod storage completely shields sharp tips

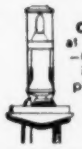
Coil layer-wound on rugged nylon spool for long, safe life



Molded rubber, moisture-tight prod handles— "No-Slip" safety rings; 30" neoprene leads

Double strength, seamless plastic case

Plastic name plate bonded to case— **no surface metal**



Coil secured at both ends —Coil leads isolated, preventing shorts

"Fog-Free" window keeps out dirt

PLUS **Famous IDEAL "DOUBLE PROTECTION"**

. . . a solenoid, calibrated indicator AND a neon test lamp, each independent of the other — NO CHANCE OF FAILURE TO DETECT VOLTAGE.

TESTS 110 to 550 Volts AC — 110 to 600 Volts DC

SOLD THROUGH LEADING DISTRIBUTORS SEE IT NOW!

MAIL TODAY FOR FULL DETAILS

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1041 Park Avenue, Sycamore, Illinois

Please send me full catalog information on new IDEAL Voltage Tester

Name_____

Company_____

Address_____

City_____ Zone____ State_____

"What Is It?"

"What kind of blankety-blank wire is this, anyway?

"We took this coil off a job some time ago, stuck it in the store room, and now we want to use it again.

"But is it heavy enough to carry the load?"

"Send it down to Engineering to have somebody figure the wire gauge, somebody says.

"Great. Gotta be miked. Gotta look up the current-carrying capacity in a handbook. Gotta get it delivered back to me. Very practical suggestion . . .

"And then, what kind of jacket has it got?

"I suppose now somebody is going to tell me to send it out to a chemical laboratory to get it analyzed.

"Not me. I'm going to sit right down and write . . .

other section of the same area approximately 20 punching machines are supplied with electric power through convenience outlets spaced at two-foot intervals along the run of Surfaceduct. Both Nepcoduct and Surfaceduct were supplied by National Electric Products Corp. of Pittsburgh.

Commenting on the installation, J. H. Kelso, foreman of the Frame Electric Company, said: "In the accounting machine area, Surfaceduct is installed just above the baseboard. There is a three-phase system for these machines. In the Punching machine area, which gets single-phase service, the runs also are mounted directly on the baseboard. We found the Surfaceduct was easy to install, even where there were corners and angles, and there is plenty of easily accessible wire space for future service demands."

In discussing the underfloor raceway installation, Mr. Kelso said: "We made the installation in accordance with the desk layout plans, as originally drawn. With the convenience outlets at every 24 inches, there is a sufficiency of outlets available to permit changes in furniture layout, yet the surface installation eliminates costly wall repairs should extensive layout or partitioning revisions be necessary."

SAFE TEMPORARY SERVICE is provided to building trades on jobs where the C. A. Langlais Company, prominent San Francisco electrical contractor, is doing the electrical work. Four 20-ampere, 2-pole, grounded receptacles enclosed in box and cover, are mounted near the bottom of a ⅝-in. plywood board (19½-in. by 35½-in.) large enough to cover the "tub" opening of a standard lighting distribution panel. After receptacles are connected to circuit breakers or switches in the "hot" panel, the plywood cover is mounted to the tub with four bolts which fit the standard holes for the panel trim. Advantage: panel interior is protected from unauthorized tampering and other damage until permanent outlets in the building are energized and conventional trim can be added to panel.

"No Question ABOUT TYPE OR SIZE"

The tough 60% *by weight* Neoprene protecting jacket on all

BRONCO 60 *Certified*

portable cords and cables is **BRANDED** with

THE NAME—BRONCO 60 NEOPRENE *CERTIFIED* . . .

THE TYPE—SO, W, G, or WELDING CABLE . . . .

NUMBER OF CONDUCTORS—1, 2, 3, 4, 5, 6, 7, 8 . . .

THE SIZE—18, 16, 14, 12, 10, 8, 6, 4, 2, 1, 1/0, 2/0, 3/0, or 4/0

VOLTAGE—300V, 600V, etc.

P116BM—approved number of the U.S. and Pennsylvania Bureau of Mines.

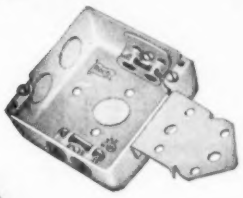
SELF-MEASURING!

The branding is repeated every two feet. Want 20 feet of cable? Count 10 BRONCO's and cut.

Furthermore, we brand BRONCO cords because we are proud of the way they perform. Years from now we want you to be able to identify the cord or cable that has delivered such outstanding continuous service.

WESTERN INSULATED WIRE CO.
LOS ANGELES 58, CALIFORNIA

COBX
For Metallic Cable



COB-½
For Conduit

COBLX
For "Flex"

3 RACO boxes that give twice as much wiring space...

These RACO electrical boxes handle double the capacity of the usual box — as many as *eight* number 12 wires — at a cost of only a few cents more. Think what this means in extra wiring space and reduced cost. Here is another example of the installation speed, convenience, and economy that are found in RACO electrical boxes. They are available nationally.

You can always rely on RACO

RACO

ALL-STEEL EQUIPMENT Inc.—800 Kensington Ave., Aurora, Illinois

"A BOX FOR EVERY NEED"

It's Quiet

THE *New* ARROW-H&H LIFETIME *Quiette* SWITCH

- **QUIET MECHANICAL OPERATION (without MERCURY or other FLUIDS)**
- **ENGINEERED AND CONSTRUCTED FOR LIFE-LONG DEPENDABILITY**

Designed for Modern Living

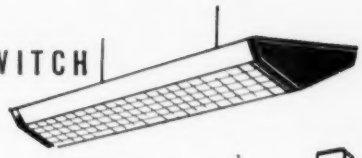
In the nursery, the public library, the conference room — and everywhere that silence is golden — there is a golden opportunity to provide an important plus value with the new Arrow H & H QUIETTE Switch. Modern living demands thinking, working, entertaining, sleeping or just relaxing uninterrupted by disturbing noise — like the snapping click of a tumbler switch. Smooth, quiet and entirely different from any other, the Arrow H & H QUIETTE Switch assures new standards of comfort and efficiency.

And quiet operation is only part of the plus value. Developed and produced by The Arrow-Hart & Hegeman Electric Company — a name long synonymous with only the highest quality in wiring devices and other electrical equipment — the QUIETTE Switch incorporates every detail of advanced design, selected materials and careful manufacture that can contribute to making it truly the finest, longest lived, most dependable wiring device switch available anywhere at any price.

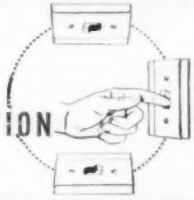
New UTILITY *Added Appeal* FOR:

RESIDENCES
NURSERIES
BED ROOMS
LIVING ROOMS
SICK ROOMS
DINING ROOMS
TV ROOMS
HALLS
BATHS
RECREATION ROOMS
STUDIES
SCHOOLS
CONVALESCENT HOMES
CHURCHES
LIBRARIES
AUDITORIUMS
HOTELS
RESTAURANTS
OFFICES
INDUSTRIAL PLANTS
SHOW AND DISPLAY ROOMS
CONFERENCE ROOMS
RECEPTION ROOMS

THE ARROW-H & H LIFETIME *Quiette* SWITCH IS THE *Only* QUIET SWITCH THAT . . .



Operates IN ANY POSITION



Can BE USED FOR BOTH FLUORESCENT *AND* STANDARD LAMPS

Offers THESE ADVANCED FEATURES

- **BACK-WIRED** — and optional side wiring — for fast, easy installation with neater, safer connections. When old loops break off in replacement jobs, wires are simply and securely connected by back wiring. A handy Wire Strip Gage is included on the back plate.
- **COMPACT SIZE** — leaves plenty of room for easy wiring.
- **FULLY ENCLOSED MECHANISM** — helps to keep out foreign matter . . . increases dependability.
- **SILVER ALLOY CONTACT TIPS** — for the ultimate in electrical efficiency and resistance to wear.
- **STURDY BAKELITE BODY** — of the finest obtainable commercial Bakelite for ruggedness.
- **SPECIFICATION GRADE** — A.C. only

APPROVED BY UNDERWRITERS' LABORATORIES—OF COURSE

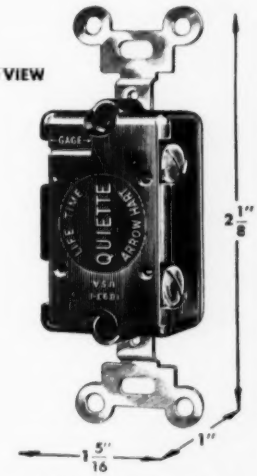
Available RIGHT NOW

H & H and Arrow Electrical Distributors have a complete stock of QUIETTE Switches on their shelves *now*. Backing him up are stocks in factory warehouses nearby. See your Distributor today and try out the Arrow H & H QUIETTE Switch for yourself — your customers will be asking about it, because it's . . .

Promoted TO YOUR CUSTOMERS

We know that when wiring device users everywhere — your customers — hear about the Arrow H & H QUIETTE Switch, they'll want it. So A H & H is promoting this revolutionary new switch directly to these people with the largest, most complete program of this type in the history of wiring device selling. By advertisements and news releases in the magazines and newspapers, at Home Planning Service Centers in prominent department stores and with descriptive folders, your customers are being told about the Arrow H & H QUIETTE Switch . . . and told that it and other quality wiring devices are available through *YOU*.

REAR VIEW

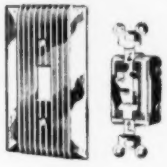


15 Amps. { 120 Volts, A.C. only / 277 Volts, A.C. only
20 Amps. { 120 Volts, A.C. only / 277 Volts, A.C. only

Single-Pole and Double-Pole
3-Way or 4-Way

Ivorylite or Brown Bakelite Operating Handles, or Lock-Type with Key

Fits Regular UNILINE WALL PLATES OR METAL TUMBLER PLATES



Wiring Device DIVISIONS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY

1705 LAUREL STREET, HARTFORD 6, CONNECTICUT

Branches in: Boston, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, San Francisco, Syracuse. In Canada: Arrow-Hart & Hegeman (Canada) Ltd., Mt. Dennis, Toronto.

Century's 28 Branch Offices located in the principal cities of the United States are prepared to help you get your share of the Electric Motor Market anywhere.

When you require help at the point of sale, a friendly Century Application Engineer, backed up by more than 50 years of motor application "Know-How" and background, will supplement your selling efforts.

The wide line of Century motor types and sizes has an important sales value. The complete line provides a means of selecting a motor that exactly matches the performance required of the driven equipment. This means giving your customers all the top performance that is built into their production equipment. That kind of service is essential to really make satisfied customers.

Invite a member of Century's nation-wide organization to help you make it easy to sell electric motors to your markets.

Century C MOTORS

CE-751

OFFICES AND STOCK POINTS IN PRINCIPAL CITIES

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri

Motor Shops

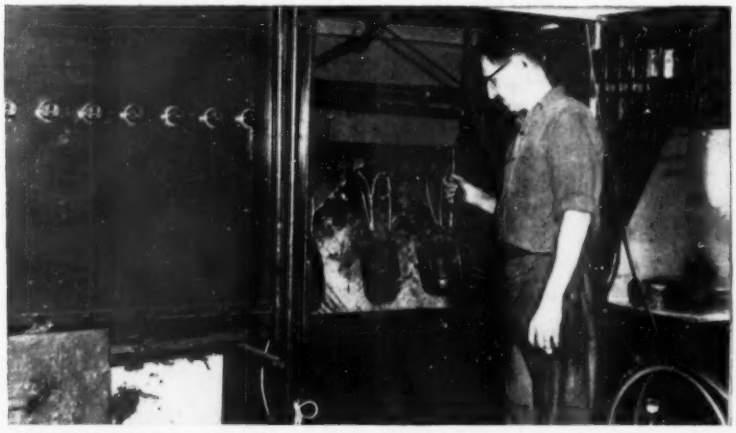
PROTECTIVE SLEEVE of varnished cotton tubing placed over wires being fed to coil winding head keeps wires together and protects hands and clothing of winder. Ruth Harris of Phoenix Electric Co., Mansfield, Ohio, who won a NISA Contest award with this idea, demonstrates use of protective sleeve (arrow) on winding machine. She finds it easier to move wires from one guide notch to the other and can wind faster when using sleeve.

Infrared Tunnel Is Adjacent To Dip Tanks

Dipping and drying, two operations which are generally considered as a single operation, are facilitated by a practical unified work center in the shop of H. N. Crowder Jr., Allentown, Pa.

There the dipping tank is flanked by an infrared tunnel consisting of two banks of lamps, facing each other along the two sides of the tunnel and switched in groups to permit the operator to regulate the intensity and location of heat. A monorail runs down the center of both tank and tunnel and a small hoist is located above the tank so it is a simple operation to lower coils for impregnation, raise them for a dripping interval, then push them into the tunnel for complete drying.

Coils may be conveniently handled in groups since they are suspended from bars equipped with hooks on 2-inch centers, and end links that slip over bar carrier along the monorail.



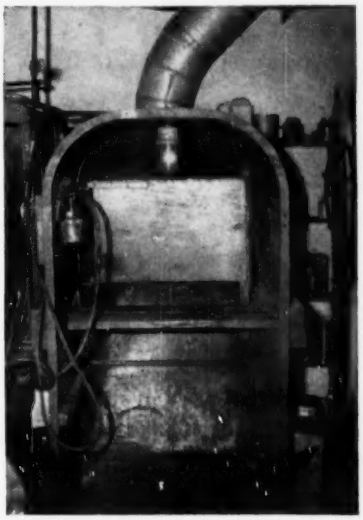
ELECTRIC HEAT is supplied by group-switched infrared lamps located in drying tunnel placed conveniently adjacent to dipping tank. Hook-equipped suspension bar and monorail running from tank into the tunnel simplifies the dip-drip-dry cycle in H. N. Crowder Jr.'s shop.

By this arrangement, the number of operations is reduced, time is saved, space is kept at a minimum and cleanliness is maintained in the central shop area.

Practical Details for Small Paint Spray Booth

Two relatively minor details have resulted in a conservation of paint, reduced "housekeeping" and a more uniform finishing of small motors sprayed in the shop of Walter J. Rider, Binghamton, N. Y.

The first detail is a baffle installed at the back of the booth, located in front of the exhaust outlet and positioned several inches out from the rear wall of the spraying compartment.



BAFFLED by the plate positioned over the exhaust duct opening in the rear of this booth, paint spray is not sucked directly into the airstream and a more uniform finish results.

With this in use, paint sprayed on a motor is not sucked directly into the exhaust duct, and the exhaust path is directed generally along walls and roof rather than concentrated in a small local area. With the paint spray thus hindered from being drawn directly into the exhaust duct, paint is utilized more efficiently. Likewise, since exhaust airstreams are diffused rather than concentrated, the paint application is more uniform and the resultant finish is noticably improved.

The second detail is not visible in the accompanying illustration, because it consists merely of a thin coating of

Instant HEAT

that's "QUICK ON THE TRIGGER"

and "RIGHT ON THE TARGET"

USE THE

WALL

TRIG·R·HEAT

SOLDERING IRON

READY TO SOLDER IN SECONDS

$11.95

HEAT-CONTROL *Thermostatic Action guaranteed for the life of the iron, or double your money back!*

Yes—the heat is QUICK! Just touch the trigger, and in seconds TRIG-R-HEAT is ready to solder. Heat is RIGHT, too! An amazing, exclusive thermostatic action *(without the use of transformers or fragile thermostats),* quickly brings TRIG-R-HEAT to "on-the-target" soldering temperature and *keeps* it there. Iron is never too cool for efficient work—never too hot for the good of the tip. The result—solder doesn't fuse to iron, so tips last two to three times as long as those on irons without this exclusive feature. A built-in spotlight makes dark, hard-to-reach places easy to solder. Wattage starts at approximately 400 watts and idles at about 100 watts. Operates on 115-120 volts, AC or DC. Get Wall TRIG-R-HEAT at your dealer's *today!*

OVER 20,000,000 SOLDERING PRODUCTS SINCE 1864

SOLDERING PRODUCTS WALL The Safety Line SINCE 1864

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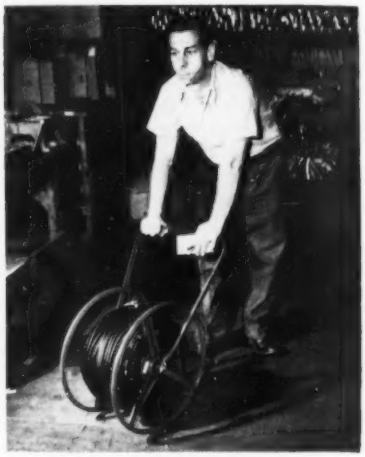
GROVE CITY • PENNSYLVANIA

grease applied to the walls and roof of the booth. However, when it becomes necessary to clean the surfaces of the enclosure, the interior can be wiped clean, quickly and effectively, by either a crumpled newspaper or a hand full of waste material.

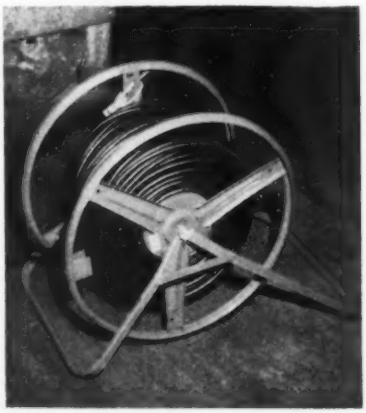
The shelf on which the motors are placed for painting consists of several 2-by-8 planks resting in angle iron side brackets, and the paint spraying unit is a standard 1-quart trigger-operated spray gun. A vaporproof lighting unit in the roof furnishes ample illumination for this operation.

Motor-Lead Wire Stored On Hose Reel

The conventional push-type metal storage reel for standard garden hose has become a very handy piece of equipment in the motor repair department of Torrence Electric Company in Rock Island, Illinois. Both the stockroom clerk and shop men agree on that.



IT'S AN EASY roll from stockroom to repair bench when heavy lead-wire is on this push-type hose reel.



WHEN TIPPED BACK, reel handle forms stand for easy payout of wire from rotating hose carriage.

DOUBLE PROFITS

from super-speed *Ramset System*

FASTENING SYSTEM

for steel and concrete fastenings

You gain double profits from split-second powder fastening into steel or concrete with long-proved RAMSET SYSTEM. *First*—it takes only seconds with the compact, light-weight JOBMASTER. Just load, position, check and RAM! The job is done instantly. No other tool can match the ease, speed and economy of the JOBMASTER:

One-piece tool . . . visi-chek button . . . trigger action manual safety control...spall diverter...angle-fire control 42-position Roto-set safety shield, for pin-point accuracy and highest speed continuous work even in tight spots.

Thousands of users have proved for six years the time-saving, money-saving advantages of RAMSET SYSTEM, now brought to highest efficiency with the new, improved JOBMASTER.

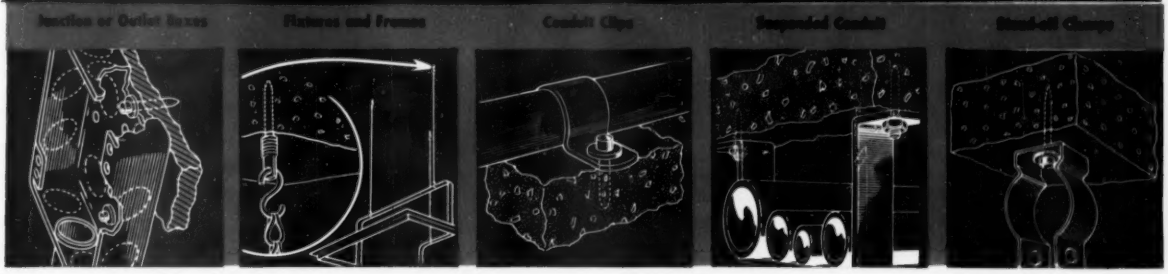
56 sizes and types of Tru-Set Fasteners

RAMSET'S second big profit maker is the widest range of studs and drive pins in the industry—lengths from ½" to 6"—diameters from ⅛" to ¼", a size and type for every job. Only Tru-Set Fasteners have the Red-Tip Pilot, to guide them straight and true to the work, for firm, accurate penetration.

Ask your RAMSET Dealer for on-the-job demonstration and for the most authoritative booklet on powder fastening—*Modern Fastening Methods*. Or, write us for details.

Ramset Fasteners, INC. *Ramset Division, Olin Industries, Inc.,* **12117 Berea Road, Cleveland 11, Ohio**

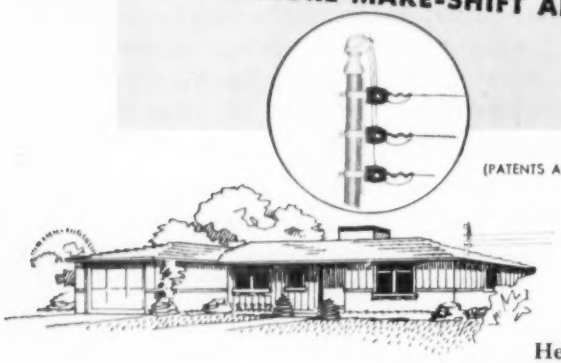
Ramset does hundreds of jobs like these...*FASTER, EASIER, AT FAR LESS COST*



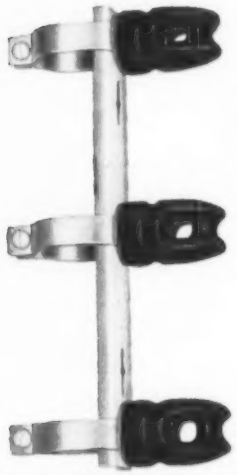
It's new!

PIPE MOUNTING HOUSE BRACKETS

NO MORE FUSSING OR FUMING
NO MORE MAKE-SHIFT ARRANGEMENTS

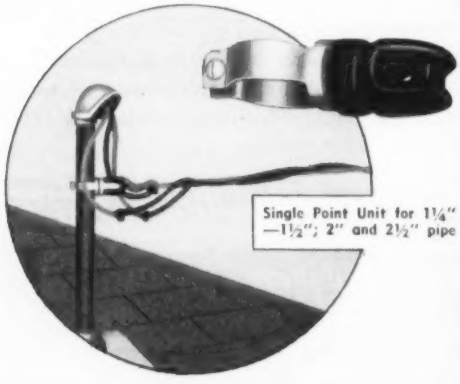


(PATENTS APPLIED FOR)



Three Point Unit 4½" or 6" wire spacing, for 2" and 2½" pipe

Here's just what you've wanted all along. Porcelain Products offers you the *first* easily attached, low priced Pipe Mounting House Bracket for use wherever you fasten electrical conductors to pipe. They're perfect for residential, industrial or rural wiring jobs . . . ideal for ranch type housing with wide eaves. Save time . . money . . avoid costly delays. Write for prices, literature.



Single Point Unit for 1¼" —1½"; 2" and 2½" pipe

PP INC.

Porcelain Products, Inc.
FINDLAY, OHIO

Instead of hose, however, the reel contains a coil of heavy motor-lead wire. Biggest advantage is the ease with which the wire can be rolled from the stockroom to the repair department where mechanics are installing motor leads between the stator terminal box and coil connections. There the reel assembly is tipped back until the handle reaches floor level and becomes a stand. The wire is then pulled off the rotating reel and cut to desired length.

A standard battery-clip fastened to a reel spoke securely anchors the loose coil end when the reel is being moved or stored. Wire size identification is noted on a brass tag bolted to the outer surface of a reel spoke. Torrence uses this push-type reel for lead-wire ranging from No. 8 to No. 2 in size. The time spent re-reeling coils of wire on the hose carriage is more than offset by the other advantages offered by this method.

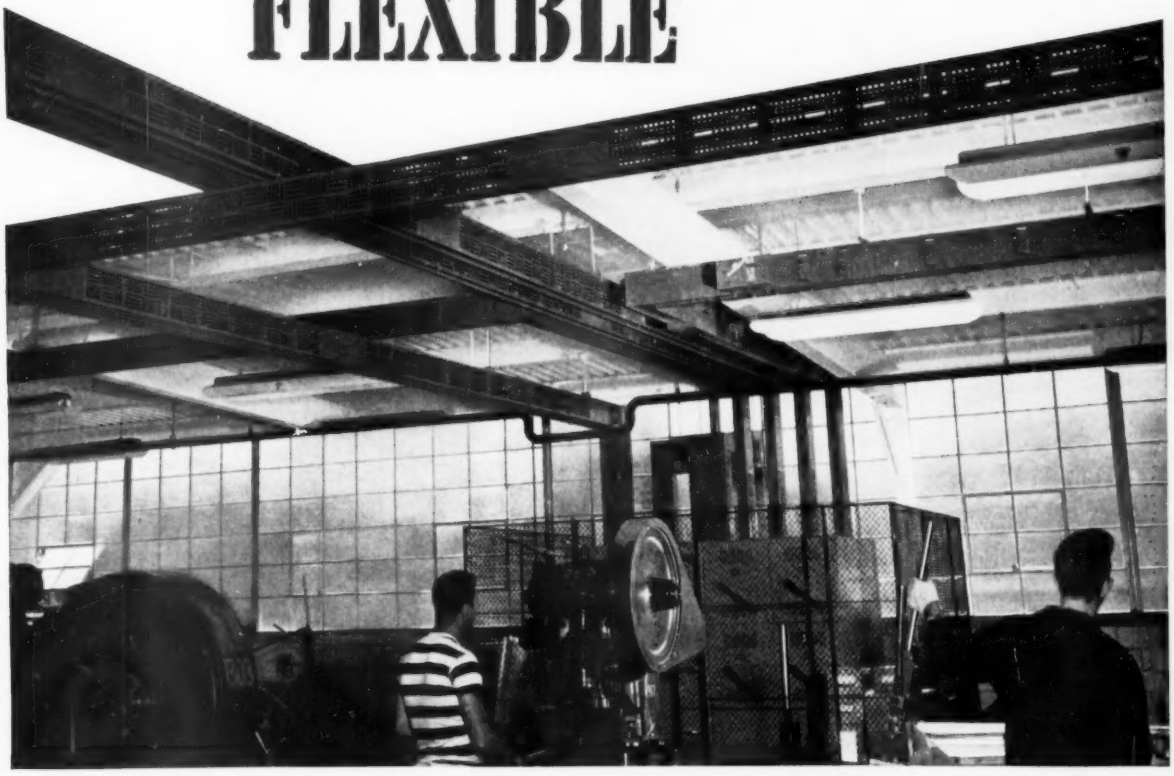
Vacuum Cleaner Makes Small Exhaust Unit

There are many operations associated with a motor repair shop that call for a small exhaust unit to keep lint, sawdust, metal dust or similar air-borne particles from becoming a nuisance. Where the area is large or permanently located, an exhaust hood and fan answers this problem, but portable units rarely receive the benefit of a separate dust collecting arrangement.

A practical answer to this problem comes from the Warwood Armature Repair Company of Wheeling, W. Va., where reconditioned vacuum cleaner

IN THE BAG is the lint which is skinned from coil ends by the insulation cutter here shown. With a reconditioned vacuum cleaner inverted beneath the skinning wheels, and with the two motors operated by a common switch, vacuum becomes automatic and lint collection is positive.

BUS DUCT IS FLEXIBLE



"It's So Flexible To Plant Layout..." says The Randall Company

The Randall Company officials stated, "It's so flexible to plant layout and production line shifts that it's just what we need for future changes and expansion."

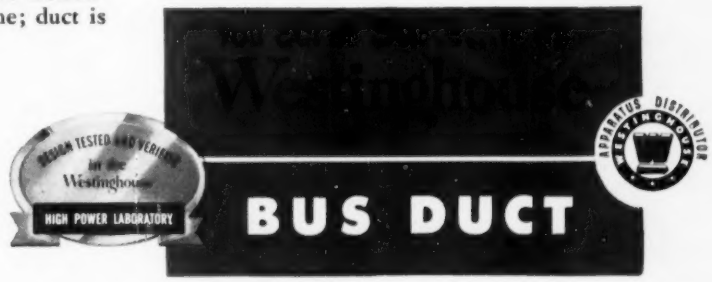
"The ease of installing your Bus Duct was amazing . . . it saved us both time and money," said the contractor, Mr. Edward P. Fogarty, President of Fogarty Electric Company, Cincinnati, about this job.

This large installation of Westinghouse Low Impedance and Plug-In Bus Duct is in the Randall Company plant at Wilmington, Ohio. It is assembled from standardized sections that allow rapid dismantling and reassembly without waste of time; duct is fully salvageable.

Up to 5,000 amperes, Westinghouse Bus Duct provides more power per pound of equipment than any system of wireway, cable or conduit. Four types are available to handle all load requirements, meet all service conditions in your plant or building from power source to outlet.

Get complete facts by calling your Westinghouse Distributor or write for B—5835, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-30108-A



AS THE CONSTRUCTION INDUSTRY

MOVES AHEAD . . .

You can depend on GENERAL CABLE

...as always

Only through alertness to industrial growth can a manufacturer anticipate the demands of a fast moving industry. And so it is at General Cable—for over 70 years a dependable, ever-expanding source for thousands of different wire and cable products. With one standard of quality—the highest possible—General Cable's vast service and manufacturing facilities stretch across America to make fast delivery an actuality on every construction job—in every section of the country.

When considering wire or cable, specify General Cable!

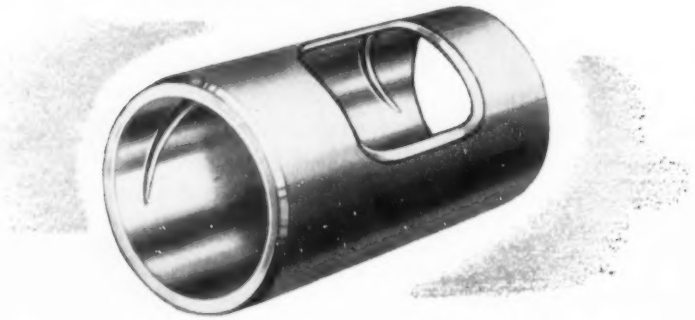
"More Power to You"®

GENERAL CABLE
CORPORATION

EXECUTIVE OFFICE: 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK • SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

This time-saving tool removes the old bearing and perfectly aligns the new Wagner bearing in one easy operation. No pounding . . . No reaming . . . No spoiling.

Wagner Bearings stand heavy pressure without scoring shafts!



Here's Why! Genuine Wagner bearings are steel-backed—babbitt-lined—precision-bored. Laboratory tests proved them able to stand heavy pressures with a low temperature rise. No shaft-scoring developed and bearing wear was negligible, even after 2½ years of continuous operation under a belt pull of many times full load! These bearings are also highly resistant to corrosion and have excellent anti-seizure properties.

Write for your copy of Catalog MU-40 and for Fast-Moving Bulletin MU-122. Every repair shop needs these helps, and they're yours for the asking.

Wagner Electric Corporation EST 1891

WAGNER ELECTRIC CORPORATION
6413 Plymouth Ave., St. Louis 14, Mo., U. S. A.

MOTORS · BEARINGS · STANDARD ROTORS
BRUSHES · CAPACITORS · COMMUTATORS

OVER 750 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

MS53-3

motors and dust bags are used for this purpose. One example is the wire skinner pictured in the illustration, where a lint-collecting hood has been constructed around the two insulation-skinning wire wheels, and a vacuum cleaner motor mounted upside down beneath the skinner assembly. With a common switch used for both units, the vacuum is created whenever the skinner motor is activated and all lint from the wire ends is sucked immediately from the air.

The assembly is conveniently mounted to a plywood and angle-iron frame which, in turn, is fitted with free-rolling casters so the unit can be moved from bench to bench if desired. An extension cord and twist-lock grounded plug permits the unit to be plugged into a convenience outlet in a number of locations. In its normal operating position, the bench is placed with the open back against one of the shop walls so the vacuum bag is hidden and protected from mechanical injury.

Winder Attachments Stored On Labeled Rack

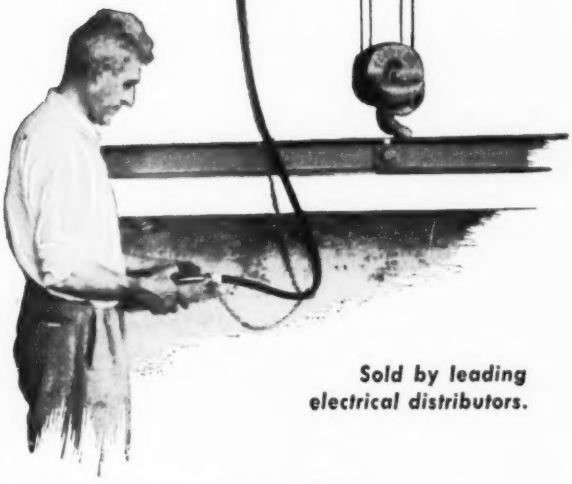
In an effort to keep in one place all attachments and tools needed in connection with their coil winder, employees of George Lockwood's Trenton, N. J., motor repair shop constructed a 24-by-30-inch sheet-steel floor-mounted panel, reinforced by angle irons. Fitted with hooks, slotted shelves and supporting bolts, each item can now be safely stored and, through a series of identification labels, misplacement or loss of items is now rare.

HOOKS AND SLOTTED RACKS are arranged on this board for the storage of winder attachments. With "a place for everything and everything in its place", neatness of the shop is enhanced and misplacement or loss of attachments is practically non-existent.

Feedrail system provides the power for a monorail hoist with slide switches and turntable in a sewerage disposal plant in Brooklyn, New York.

ELECTRIC FEEDRAIL *Flexibility*

Simplifies Plant Problems



Sold by leading electrical distributors.

Feedrail is a flexible system of electrical distribution. It powers small or large hoists with equal ease. Mobile power trolley outlets supply power to crane or hoist. It's a simple problem to power a hoist on a curve, slide switch, transfer, turntable or spur run. Easily and quickly installed it provides a safe, dependable power source and requires little or no mainteance.

Feedrail offers new freedom in planning plant layout and production schedules. Trolleys roll smoothly within the enclosed track and current is immediately available where needed. Trolleys are added in a matter of minutes without shutting off the power.

Unit powered equipment and men move into line at a moment's notice to break "bottlenecks" at overloaded work centers. This flexibility is a vital factor in lowering costs and raising production volume. A factory fabricated Feedrail system will solve your electric power distribution problems. Write for literature.

46-D

Never Becomes Obsolete

ELECTRIC FEEDRAIL®

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc.

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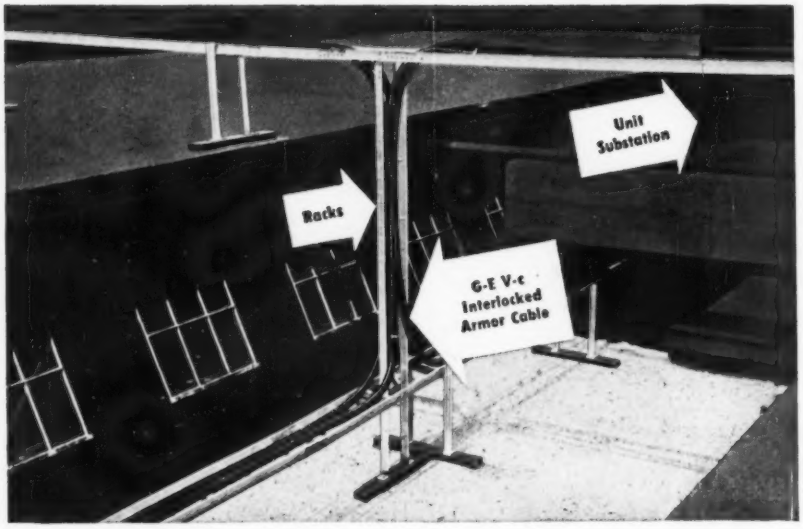
How to Modernize a Plant's Power Supply System in a Hurry



Utilize existing structures... and the G-E V-c INTERLOCKED ARMOR CABLE SYSTEM

To distribute power in a modernized plant, an eastern manufacturer used 12 G-E unit substations on the roof and then installed a G-E V-c interlocked armor cable system to bring high-voltage power to these substations. More than a mile of G-E V-c interlocked armor cable was used. The cable was 3-conductor #2/0, 15,000-volt, No. 1799 varnished-cambric-insulated with a thermoplastic jacket and bronze armor.

Underground duct work would have meant costly tearing up of concrete floors. And an ordinary conduit installation was not feasible because of the uneven contour of the buildings' roofs. Either of these methods also meant more installation time and more cost for materials.

Aluminum racks

Aluminum racks, only 12 inches wide, were used to carry the cable over the many rises, slopes, and bends on the roofs. Because the G-E V-c interlocked armor cable system is light and flexible, no difficulty was experienced in pulling long lengths by hand over and around the bends and angles.

Easy to inspect

G-E V-c interlocked armor cable on racks is always open for visual inspection — always accessible — quickly spliced with simple mechanical joints. To our knowledge, no installation of G-E V-c interlocked armor cable has ever suffered mechanical damage sufficient to cause electrical failure. It will pay you to investigate the G-E V-c interlocked armor cable system. For more information, write Section W64A-518, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

Easy to bend.
Corners and projections present no installation problems for the G-E V-c interlocked armor cable system.

ESTIMATED INSTALLED COSTS FOR 15,000-VOLT CABLE

	Conductor Size	Method of Installation	Amperes*	Installed Cost per 100 Feet per Ampere
Varnished Cambric Insulated Interlocked Armor Cable	**2/0**	**Racks**	**185**	**$2.80**
Rubber-Neoprene	3/0	Steel Conduit	197	4.20
Rubber-Neoprene	1/0	Messenger	182	3.10

*Based on 77 C copper for V-c and 80 C copper for rubber-insulated cables at 40 C ambient.

You can put your confidence in—

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

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CATALOGS, BULLETINS
ADVERTISEMENTS

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ELECTRICAL CONSTRUCTION AND MAINTENANCE—A McGraw-Hill Publication

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ADDRESS .....
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New York 36, N.Y.

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330 West 42nd St.,
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NEW PRODUCTS CATALOGS, BULLETINS ADVERTISEMENTS

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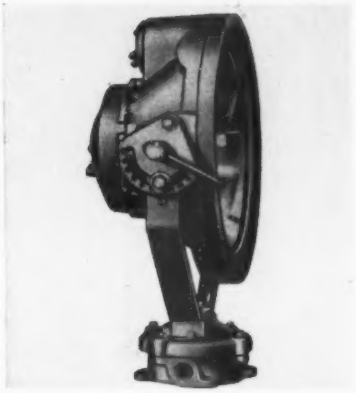
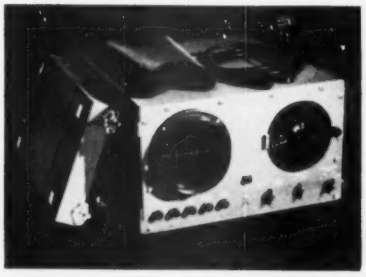
Product News



Floodlight (1)

A new 500-watt explosion-proof floodlight, the RLEE-14, for use in hazardous locations. It has a heavy, tempered and inpact-resisting lens as well as a separate explosion-proof wiring compartment in its base that is isolated from the lamp compartment by an explosion-proof seal. Other features are high efficiency Alzak aluminum reflector, easy access for relamping and focusing from rear and degree-marked aiming quadrants. Connections for use with flood light, available in any required length, are conduit or Type EC explosion-proof flexible couplings.

Crouse-Hinds Co., Syracuse 10, N. Y.



Analyzer (2)

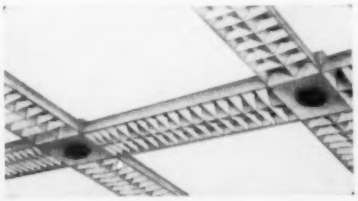
Model 124 line fault analyzer locates power line faults at ranges from ½ to 200 miles. Operating from any powerhouse, transformer bank or substation, it pinpoints shorts, grounds or open circuits. Instrument is direct reading and can be attached to any line using regular carrier coupling capacitors. Tests can be made phase to phase or phase to ground. Instrument is weatherproof and portable and is unaffected by climatic conditions. Operating on radar techniques, it sends high amplitude pulse down the line under test. A complete picture of the line is presented on a built-in radar-type "A" scope. Calibrated linear sweep ranges of 5, 25, 50 and 100 miles are provided. A sweep delay circuit is provided to extend the range of the instrument to 200 miles, or to allow a small section of the line to be displayed for detailed study. Instrument operates from a 105/125 volt ac supply and includes viewing hood and power cord.

Sierra Electronic Corp., San Carlos 2, Calif.

Silicone Varnish (3)

Silicone varnish 997 is a new Class H dipping and impregnating varnish that has over 100 times the dielectric life of typical Class B varnishes at 200°C and shows less tendency to bubble on curing. Total processing times are therefore comparable to those required for Class B machines and only ¼ to 1/7 as long as those previously required for Class H equipment. Class H equipment impregnated with varnish 997 can be placed directly into an oven at 400°F without bubbling. For dipping or impregnating electrical equipment the viscosity of varnish 997 should be maintained at 100 to 220 centipoises. It can be mixed in any proportions with varnish 996.

Dow Corning Corp., Midland, Mich.



Fluorescent Luminaires (4)

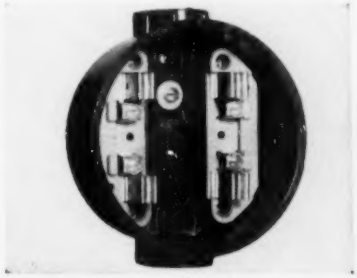
A new series of fluorescent luminaires, named Astra-Lite, for commercial, industrial, and institutional uses. System is based on two primary units which combine into a multiplicity of continuous run arrangements such as square, rectangle, "T", "S", "U", "X" shaped and many other layout arrangements. First unit is a two-lamp, steel luminaire in lengths from 4 to 8 feet. It uses G.E. or Jefferson E.T.L. certified ballasts and is finished in triple-sprayed, plastic-base enamel, infra-red baked. Available in bi-pin or slimline style, with plastic or steel side panels, instant or rapid start, louvered or unlouvered. Louvers provide a 35° cutoff. Second unit is a square element, illuminated, non-illuminated or gimbal ring spot which serves as a connector, corner or intersection. It also features the ability to use existing outlets without additional wiring, spring clip assembly so that one man can clean or relamp any size fixture from a single position and a bolting and mounting system which assures perfect alignment.

Metalcraft Products Co., Inc., Mascher and Lippincott Sts., Philadelphia 33, Pa.

Ballasts (5)

A new line of ballasts for operating fluorescent lamps in outdoor plastic signs. They are equipped with weatherproof leads and low temperature capacitors. Capacitors have a special dielectric which permits their normal operation over a wide range of temperatures and as low as 30° below zero. The line contains ballasts for operating two instant start, 42T6, 48T12, 64T6, 72T8, 72T12, 96T12 slimline fluorescent lamps. Ballasts are lead-lag design and can be furnished with 200, 300 or 426 MA output. They are listed by Underwriters' Laboratories and certified by Electrical Testing Laboratories. The ballasts are designed for installation along with the lamps inside the sign.

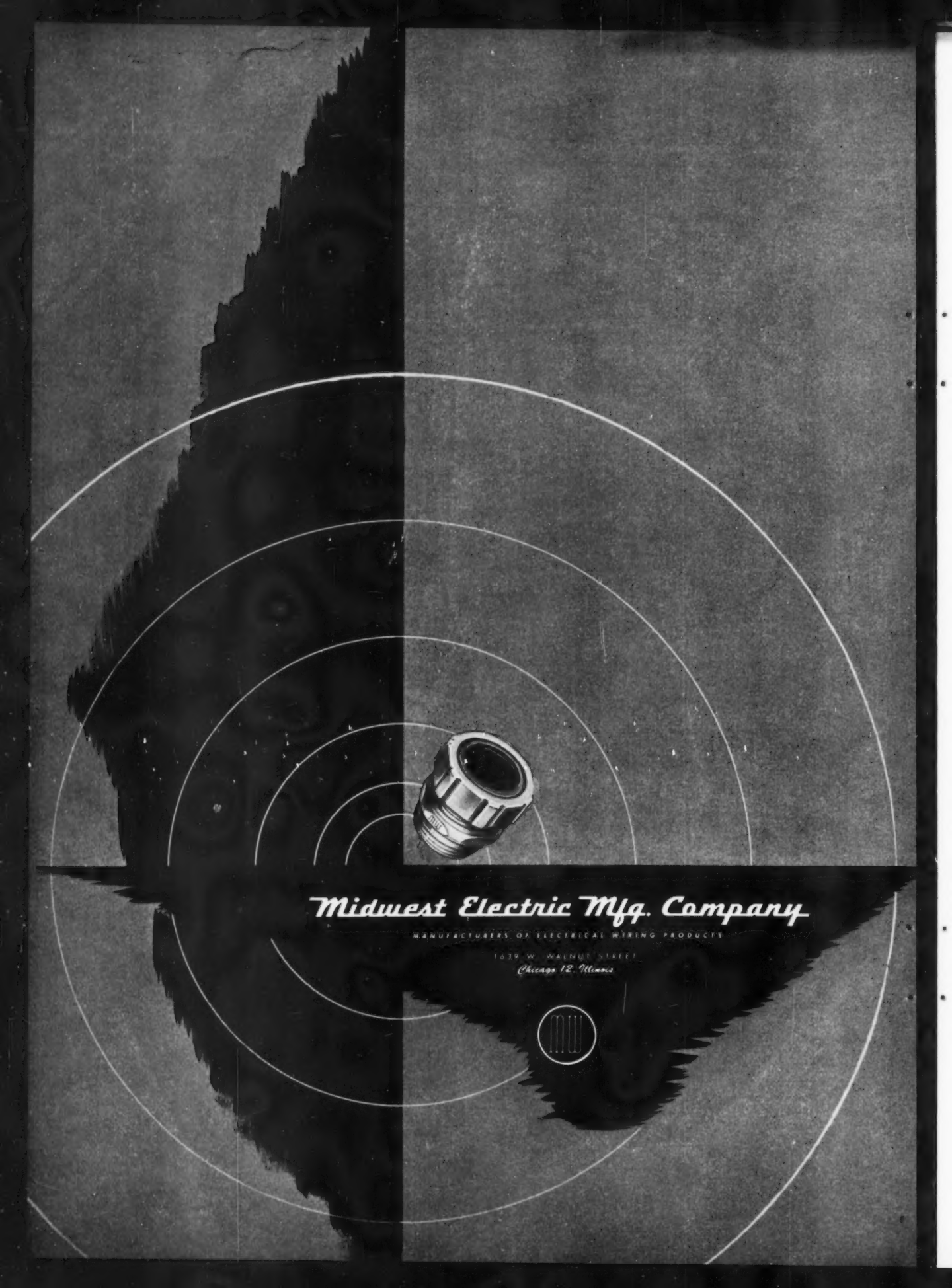
Jefferson Electric Co., Bellwood, Ill.



Meter Socket (6)

A new weatherproof, watertight die cast meter socket. The watt hour meter socket is designed with reversible jaws which can be reversed in the field for vertical or horizontal mounting. Increased working area is one of the principal features; external conduit hub openings provide maximum working area within the enclosure. Finished in blue-gray baked enamel, enclosure is made from aluminum alloy to ASTM and U. S. Government standards. Jaws and terminals of socket are mounted on a heavy duty type insulating base. Pressure type solderless connectors. Line and load terminals will accommodate No. 1 wire. Ground neutral terminal will accommodate two No. 1 wires. Available in a non circuit closing type or automatic circuit closing type—with or without conduit break-out in back.

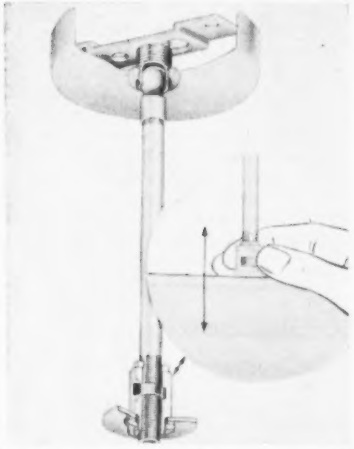
Square D Co., 4335 Valley Blvd., Los Angeles, Calif.


Midwest Electric Mfg. Company
MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS
1639 W. WALNUT STREET
Chicago 12, Illinois

Switches (7)

A new line of standard duty safety switches is available in ratings of 30, 60, 100 and 200 amperes, 240 and 600 volts, two, three and four poles. Known as standard duty HCI, this line is designed to meet all but the most severe operating demands. It incorporates a pole unit which is a self-contained switch. Pole unit features a unique arc-quenching action which is similar in principle to the arc-extinction features of modern circuit breakers. HCI has quick make—quick break action, interlocking cover and hp ratings. It meets NEMA Type A standards and is listed by Underwriters' Laboratories, Inc.

Trumbull Electric Department, General Electric Co., Plainville, Conn.



Lighting Fixture Hanger (8)

A new type of lighting fixture hanger, called the "Stem-Winder". It incorporates an ingenious stem-winder leveling device and a 25° swivel. Fixtures can be leveled after installation without need of tools. Comes complete with hickey and crossbar for outlet box ears or stud.

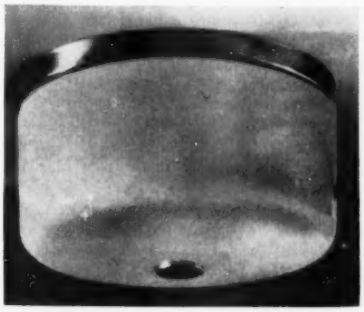
The Miller Company, Meriden, Conn.

Speaker-Driver Unit (9)

Two new explosion-proof speaker-driver units, for indoor and outdoor public address and sound reinforcement uses in locations where inflammable liquids, gases, or dust creates explosion hazards. One of these units, type MI-12461-1, has Underwriter's approval for use in such industries as dyeing, dry cleaning, paint spraying, and plastic, chemical, and gas manufacturing, or wherever inflammable liquids or gases are present. The other unit, type MI-12461-2, has Underwriter's approval for use in such industries as flour, feed, grain or starch processing coal pulverizing, and coal mining, or in any location where metallic dust, grain or similar foreign particles in the air present an explosion hazard. Both are watertight and weatherproof. They are provided with alnico V magnets and have fatigue-resistant beryllium-copper voice coil leads. Both have peak power ratings of 60 watts, and a frequency response of from 90 to 7,000 cps.

RCA Victor Division, Radio Corporation of America, Camden, N. J.

(10)

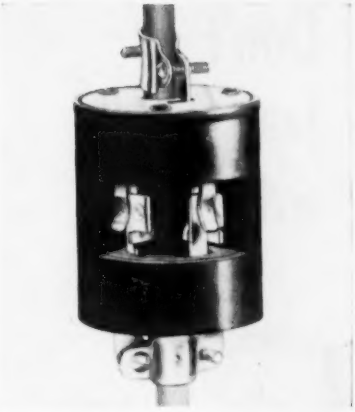


OPALITE is a shallow trim-lined utility bowl fixture with a spring assembly that permits relamping without removing bowl. It is 4¾ inches deep to fit low ceilings. Fixture consists of a white opal glass bowl diffuser secured by means of a Torsiontite spring. Approved by Underwriter's Laboratories. Applicable for home as well as commercial uses, unit is available in four diameters: 8½-in., 10½ in., 12½-in. and 14½. Manufactured by Lightolier, Inc., 346 Claremont Ave., Jersey City 5, N. J.

Fan (11)

An improved design of the Whirlaire fan that increases capacity 40% and doubles air stream penetration is available. It is made in two sizes: a 16-inch blade that delivers 4,000 cfm and a 20-inch blade that delivers 10,000 cfm on high speed. The 40% increase in air handling capacity is due to specially designed air-injector rings and the double normal penetration of the air stream is due to the air-jet vanes. Models 16WA2 and 20WA2 come with a counter type base for use on a table or shelf or for mounting on wall or ceiling. Models 16WAP2 and 20WAP2 come with a pedestal type base that has a double locking, tamperproof adjustable column. Fan head may be tilted from 30° below horizontal to vertical. Control switch is a two-speed, snap type, with the control located at the bottom of the rear grill.

Westinghouse Electric Appliance Division, 653 Page Blvd., Springfield, Mass.



Connectors (12)

Turn-Tyte's new principle in interlocking electrical connectors has made possible the first all-rubber model specifically designed for heavy industrial use. Cataloged No. 2209, it is interchangeable with all other interlocking makes. Special right-angle lugs at the tips of the female contacts engage and support the male blades, thus establishing a strain-proof, double-locked connection. Rigidly tested, the rubber body will not crack, warp or deteriorate and assures shock-proof safety under extremes of temperature and humidity. Available in five different models —2 wire; 3 wire; 4 wire—rated for 10 and 20 amps service. All are equipped with rust and corrosion resistant cord clamps. Underwriters' listed and CSA approved.

Rodale Manufacturing Company, Inc., Emmaus, Pa.

Fluorescent Fixture (13)

The "Lodestar" series of the "Milestone" line was designed for use in offices and stores. They are available with two or four lamps in 4-foot or 8-foot lengths. Features include a substantial upward component that provides a "general diffuse" effect; translucent plastic sides; louver design assuring properly shielded light; concealed spring-loaded louver latch designed for easy maintenance. Four lamp types are available—T-12 medium bi-pin, T-12 medium bi-pin instant-start; T-12 rapid-start and T-12 slimline. Shielding angle is 35° crosswise and 25° lengthwise. Units may be suspension mounted individually or in continuous rows. When luminaires are surface-mounted, an accessory reflector may be used. All ballasts, starters and lampholders are E.T.L. approved. They can be operated on 110-125 volts, 60 cycles ac.

Mitchell Manufacturing Co., 2525 N. Clybourn Ave., Chicago, Ill.

Don't just write—

Specify JENKINS

Gold Seal Tape

...and SAVE

Goes further—Here's why

GUARANTEED FOOTAGE— You get full measure with every roll. Tapes up tight to the last inch.

NO WASTE— Gold Seal Friction Tape tears evenly, won't ravel, molds to uneven surfaces.

HIGH DIELECTRIC— Less footage is needed per job. No pinholes; one thickness insulates.

LASTING "TACK"— Gold Seal sticks to the job under toughest conditions of cold and moisture.

EASY HANDLING— Gold Seal does not peel, dry out or smear the hands in hottest weather.

FRICTION and RUBBER TAPES In either 10-roll cartons or single rolls. Every roll sealed in cellophane, stays fresh. Jenkins Bros. (Rubber Division), 100 Park Ave., New York 17.

TRADE JENKINS MARK

IT'S YOUR BEST BUY FOR PLANT SUPPLY

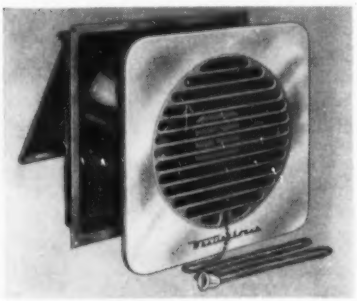
Jenkins Bros. make Diamond Seal Friction and Rubber Tapes which also meet ASTM Specifications.

Type PH-PHD
New Stream-Line Penthouse Fan

Penthouse Fan (14)

New penthouse units, Type PH and PHD, redesigned for greater efficiency and service. They are undercoated with noise deadening material. Overhanging front section has by-pass tray, discharging back on to the roof any water which may pass shutters in severe rain storms. Motors are totally enclosed or explosion-proof. Insulation on interior walls, to prevent condensation or to conserve heat, is available on both units. For units ventilating buildings with ceiling temperatures of 75°F plus, the use of automatic ceiling shutters, installed directly below the unit are recommended. When fan is turned off, shutters will prevent heated air from condensing on cold walls of penthouse. Sizes 12 inches to 60 inches, 5,000 to 40,000 CFM. PH takes belt drive fan. PHD takes direct drive fan.

Chelsea Fan & Blower Co., Inc., 639 South Ave., Plainfield, N. J.



Ventilating Fans (15)

250 cfm Poweraire home ventilating fans for permanent installations in an outside wall or ceiling are available. They are suitable for the smaller kitchens or laundry. Fans come equipped with specially designed, quiet Hemcolite S-R plastic blades, which are bendproof and warpproof. One-piece steel grille is finished with a baked-on white and gray enamel. It is easily removed for cleaning. Outside shutter is of sheet steel finished with gray enamel. Motor is a brushless, 2 pole, induction type, with die-cast, squirrel-cage rotor. Bearings are individually self-aligning, porous-sleeve type. Switch is single speed—"on" and "off" type actuated by a pull chain that operates both motor and outside shutter.

Westinghouse Electric Appliance Div., 653 Page Blvd., Springfield 2, Mass.

Volt-ammeters (16)

A series of three pocket-size volt-ammeters, in a range that measures up to 1200 amperes, is now available. "Snap-around" construction permits Amprobes to measure current instantly, without being connected to the conductor. The reading can be taken without interrupting the circuit or shutting down equipment. Voltage test leads are equipped with new retractible safety plug, which automatically insulates itself when removed from meter. Jaws are insulated down to the socket. Probe jaws are pointed. Model "300" has nine ranges up to 300 amps, ac, and 600 volts ac. Model "600" ranges up to 600 amps and 600 volts. Model "1200" ranges up to 1200 amps and 600 volts.

Pyramid Instrument Company, Inc., Lynbrook, N. Y.

Internal Growler (17)

Exact location of coil shorts in ac motor stators and armatures is revealed instantly by this new internal growler. Growler energizes suspected coils while a self contained pick-up and meter check the same coil that is excited. Unit detects coil shorts that give too weak an indication to be found by usual testing means and reveals them by a definite movement of meter needle. Once around the stator or armature gives a complete check. May be used on stators from 6 in. ID up, on armatures from 6 to 14 in. in diameter and also on rotors to detect loose bars.

Crown Industrial Products Co., Woodstock, Ill.

"Get cleaner threads, tighter joints with Buckeye Conduit!"

AN ELECTRICIAN TALKS ABOUT CONDUIT: "I agree with other electricians that "Buckeye" gives a clean and strong thread. A clean thread is essential for making a really tight, safe joint! Youngstown rigid steel conduit is tops."

ELECTRICAL ENGINEER ENDORSES BUCKEYE CONDUIT: "As an electrical engineer, I have jobs which demand wiring which must withstand vibrations and shock. By specifying "Buckeye" I protect these wires because only good steel produces threads strong enough to make tight and safe joints."

Youngstown makes rigid electrical conduit from start to finish. This enables Youngstown to control the complete manufacturing process which insures that each length of "Buckeye" is made of topgrade steel. Since only high quality steel produces a clean, strong thread, it's no wonder that "Buckeye" is a favorite in the industry. On your next job, be sure to specify Youngstown Buckeye conduit.

Shipments of Buckeye rigid steel conduit are now being made from our conduit mills at Indiana Harbor and Youngstown.

QUALITY YOUNGSTOWN SERVICE

WOOD BURN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel

Export Office-500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES

FULLMAN **Latrobe**
Electrical Products

Floor Boxes and Wiring Specialties

ADJUSTABLE WATERTIGHT FLOOR BOXES

NON-ADJUSTABLE WATERTIGHT FLOOR BOXES

ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4

NOZZLES AND FLOOR BOX ACCESSORIES

FLOOR JUNCTION BOXES

UTILITY OUTLETS

INSULATOR SUPPORTS

PIPE AND CONDUIT HANGERS

ARMORED CABLE SUPPORTS

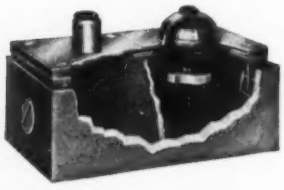
CABLE CLIPS

STAPLES

FISH WIRE

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE OUR SUPREMACY LATROBE, PA.

Fire Proof Adjustable Floor Boxes



All "Latrobe" Adjustable Watertight Floor Boxes are completely fire proof and comply with the National Electrical Code.

Adjustable Boxes come in single—round or square bodies. Also in square type Single Gang, Two Gang, Three Gang and Four Gang Boxes.

Latrobe products are easily and quickly installed.

Pipe or Conduit Hanger
Convenient and dependable for hanging pipe or conduit ½", ¾", and 1" to steel beams up to ⅜" thick.

Fullman Manufacturing Co.
1209-1215 JEFFERSON STREET
LATROBE, PA.

Time Switches (18)

New type time switch with a new and simplified tripping and switching system. A snap ON lever operated by the ON trippers on the dial and an OFF lever operated by the OFF trippers. The 24-hour time dial, moving in standard clockwise motion, carries the trippers up against these levers. A motion of ¼ inch of lever operates the heavy duty micro switch controlling the load circuit. By means of an interlocking arrangement, levers may be manually operated without interfering with the sequence of the automatic operations. Timer is housed in a steel box 4¼ inches by 5 inches by 7 inches, with hasp locked, dust-tight cover.

Lumenite Electronic Co., 407 So. Dearborn St., Chicago, Ill.

Metallic Rectifier (19)

A new line of metallic rectifier power supplies for electroplating and anodizing operations. Line includes manually controlled and automatically regulated power supplies, as well as special equipment for barrel plating and precision laboratory work. Maximum operating economy in each rating is achieved by using a variety of circuits and either copper-oxide or selenium rectifier stacks, depending on output desired. Dc ratings for new manually and automatically regulated systems range from 500 amperes at 6 volts to 2000 amperes at 48 volts. Units for barrel plating are available in ratings from 500 amperes at 6 volts to 2000 amperes at 12 volts. Laboratory platers are rated 50 amperes at 9 volts and 65 amperes at 18 volts. Saturable reactor control is employed on manually and automatically regulated power systems. A single operator's control station, for mounting beside

plating tank or adjacent to rectifier units control entire dc output of system regardless of number of individual units employed. Manually controlled systems of new line may be converted at any time to automatic regulation.

General Electric Co., Schenectady 5, N. Y.

Signal Alarm Unit (20)

A new signal alarm unit designed for modern flow line and graphic panels called Monolarm. Some of the advantages for Class I, Groups C and D, Division 2 operation are: narrow bezel and button fits into a flow or graphic line diagram without interrupting continuity of design story; occupies minimum back-of-panel mounting space; lighting indications in two or three colors on one bezel; relamping is from front of panel; instantaneous connect and disconnect of power supply cable is provided by an interlocking switch receptacle and plug; hermetically sealed plug-relays instantly removable if replacement is necessary; time delay circuit available to counteract turbulence and vibration when abnormal condition is reached.

Russell & Stoll Company, Inc., 125 Barclay Street, New York 7, N. Y.

Immersion Heater (21)

A new type of heavy duty steel sheathed immersion heater for alkaline bath heating. The Clepco-Glorod Series W immersion heater is designed for safe operating temperature of the nickel alloy resistance element which is covered by a quartz body. A sealed, vapor-proof Underwriter's approved junction box prevents entrance of liquids and vapors. When controlled by a thermostat, units are in operation only for the period of time required to maintain the desired bath temperature. Units are portable. Available as dual voltage, 230 volt and 460 volt, single phase in capacities of 1000, 2000, 3000, 4000, 6000 and 10,000 watts—overall lengths ranging from 14- to 70-inches. Brass or stainless steel protective sheaths can be furnished.

Cleveland Process Company, 7016 Euclid Ave., Cleveland 3, Ohio

Make your pick-up truck a service truck

PAINTED...READY TO INSTALL

SERVICE-TWINS

TOOL AND MATERIAL COMPARTMENTS

It's easy to install Service-Twins. You need only a wrench and drill to do the job. No painting is required. Service-Twins are finished in baked-on synthetic enamel, that's rust and chip-resistant. Color is medium-dark green.

Built-in parts bins are standard equipment. Doors have slam-action catches with cylinder locks, keyed alike. Overhead rack with material brackets, shown at right, is optional.

Service-Twins are available in 74" and 84" lengths, for ½ and ¾ ton pick-up trucks.

SERVICE-TWINS are manufactured by the makers of the famous *Service-Master*

Service-Master . . . the all purpose service body designed to take a complete workshop to the job . . . the pace-setter in the service industry. In sizes for ½, ¾, 1, and 1½ ton chassis. Weatherproof doors are fitted with recessed, slam-action catches, and cylinder locks, keyed alike. Complete with built-in shelves and bins. Optionals include removable overhead rack, pipe rack, vise support, telescopic roof, and rear bumper-step.

McCABE-POWERS AUTO BODY COMPANY
5900 NO. BROADWAY • ST. LOUIS 15, MO.

Please send me complete details on Service-Twins ☐ Service-Master ☐

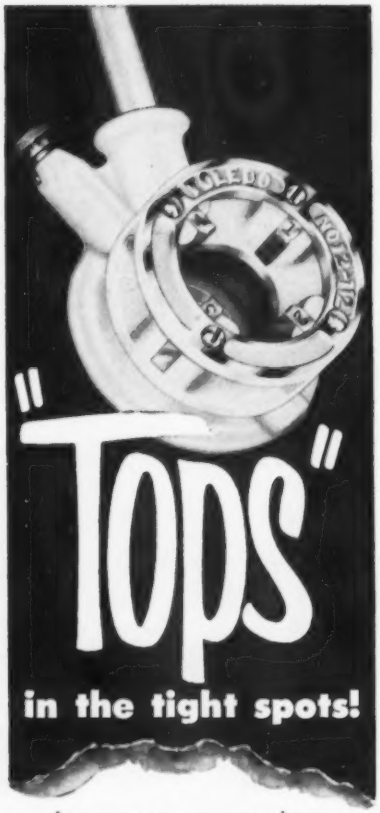
Name _____

Company _____

Address _____

City _____ Zone _____ State _____

EC



... in corners or anywhere ...

save time, cut costs with

TOLEDO

DROP HEAD TOOLS

HANDY FOR CLOSE CORNER JOBS. These popular Toledo Ratchet Threaders are small, light, compact. Produce clean-cut threads easily . . . anywhere.

QUICK CHANGE OF SIZES. Die heads drop into ratchet from either side held securely.

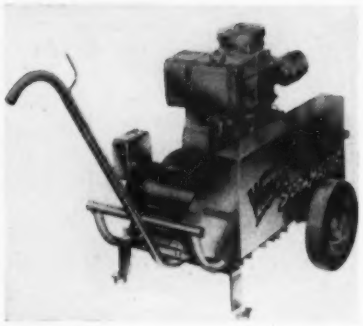
DIES OF FINEST TOOL STEEL. Precision-ground. Die segments can be reground when dull or replaced at small expense. Three models: No. 00—⅛" to ¾"; No. 11—⅛" to 1¼"; No. 12—½" to 2" pipe.

ORDER THROUGH YOUR SUPPLY HOUSE. Write for catalog 11a52. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office; 165 Broadway, Room 1310.

RELY ON THE LEADER

TOLEDO

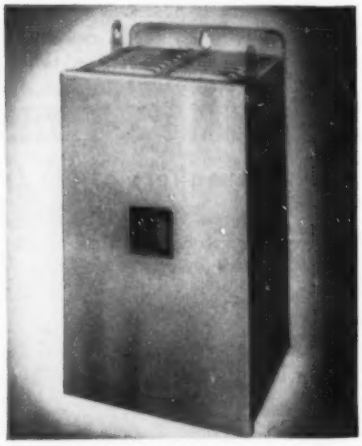
PIPE TOOLS . . POWER DRIVES
. . POWER PIPE MACHINES



Generator (22)

Winco storm master engine-generator, Model 3030-X without engine. It is designed to supply a low cost standby emergency power plant for suburban dwellers, farmers, ranchers, or anyone served by overhead transmission lines. The "Universal" mounting base consists of four slotted channels arranged in sets of two at right angles to each other, thus making a transverse mounting system with infinite adjustment within the limits of the frame dimensions. Consequently, a large number of different makes and models of engines can be accommodated. Unit is sold with or without engine. Standard engines, from lawn mowers, water pumps, garden tractors, etc., may be used. Generator output depends on size engine used.

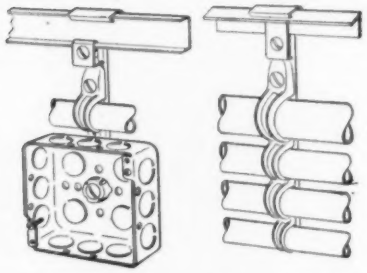
Wincharger Corporation, East 7th & Division Sts., Sioux City 2, Iowa.



Transformers (23)

A new line of encased dry type transformers. They are double wound, high temperature resistive, contain Class B insulation, glass insulated wire, and non-inflammable insulation material. The casements are fully enclosed, with knockout provided for connections and ventilating louvers. Transformer input is 240/480 volts, and 600 volts, output is 120/240 volts, and they are supplied in 1, 2, 3, 5, 7½ and 10 kva sizes. Shell-type construction means a cooler transformer without loss of operating efficiency. Easy wiring is facilitated by the use of an insulated distribution panel. Transformers are suitable for taking lighting, motor, and signal loads from power circuits; and for stepping up lower voltages for special applications.

Universal Manufacturing Corp., 29 East Sixth St., Paterson, N. J.



Single-Arm Support (24)

New single-arm support for carrying outlet boxes and conduits above hung ceilings. They attach to the carrying channels or angle irons without disassembly of the holding-clamps with which they are equipped. For use with all types of ceiling suspension and material, and with all kinds of recessed lighting. When intended for carrying outlet boxes the single-arm support is fitted with the exclusive snap-on button. This remains on the support at all times, and the proper knockout hole is pushed over the button; the box is locked by tightening a single screw. When used for conduits, four or more may be racked on a single support with half-clamps. If desirable, an additional conduit may be supported above or below the outlet box.

Fast-Lok Manufacturing Co., Inc., Ash St. at Bedford, Bridgeport 5, Conn.

Air Conditioners (25)

New window type room air conditioners include ½, ¾ and 1 ton capacities. Thermostatic control for variable cooling built in. Multiple functions are cooling, dehumidifying, filtering, circulating, exhausting and ventilating; adjustable louvers to direct air in any direction; concealed control panel ¾ ton unit is available in 115 and 230 volts. Cooling capacity ½ ton 200-300 sq. ft., ¾ ton 300-400 sq. ft., 1 ton 400-600 sq. ft. area.

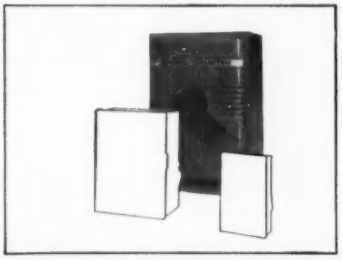
Frigid Incorporated, 128-168 Thirty-Second St., Brooklyn 32, N. Y.

3 Complete Lines

OF TRUMBULL SAFETY SWITCHES

let you fit practically any low voltage application with a new high in dollar value

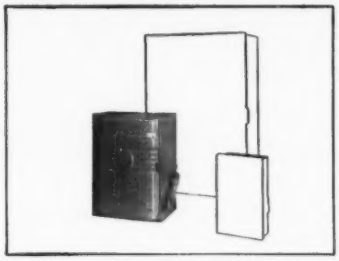
Trumbull presents a complete and superior line of safety switches, each designed for a clearly defined type of service. Trumbull has always provided the selling advantage of "more product for the customer's dollar." Now the comparison can readily be made crystal clear to contractor, specifier, and user.



***HEAVY DUTY INDUSTRIAL**

Exceeds NEMA Type A Standards

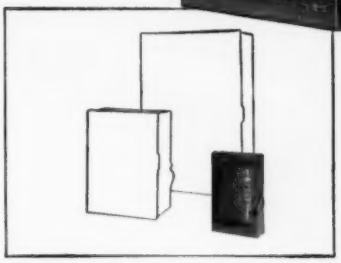
The Trumbull Style HCI Front Operated Safety Switch is without any question the finest switch ever built by Trumbull, the Safety Switch leader. It has every installation convenience, every operating and maintenance advantage, and all the protection we know how to build into a switch. Its unique and thoroughly proved pole units introduce a basically superior switching principle. It is deliberately designed and built to exceed today's requirements and last as near to forever as a switch can.



***STANDARD DUTY**

Meets NEMA Type A Standards

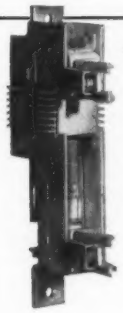
The Trumbull Style HCI Side Operated Safety Switch will meet all but the most rugged demands with *plenty* to spare. It features the HCI pole unit with circuit breaker arc quenching action. While it meets NEMA Type "A" specifications it offers substantial cost savings. No Trumbull safety switch ever offered more for the money.



GENERAL USE

Meets NEMA Type D Standards

The Trumbull Style D Safety Switch is designed for many applications where service is not severe and continued overloads unlikely. This well-engineered and sturdily built switch does its job at real savings in first cost. It is suited for use in many distribution and branch circuits, for flood or sign lighting, service entrances, heating and air conditioning equipment.



***The pole units** *of Style HCI switches feature the magnetic-repulsion principle of arc-quenching, similar to that of a modern circuit breaker. Grid pins break up and quickly dissipate the arc. Double-break visible contacts are actuated by a heavy spring, with practically instantaneous make and break. These exclusive features result in high interrupting capacity and longer switch life.*

There is a Trumbull safety switch to meet practically any application up to 1200 amperes, 600 volts AC or DC.

TRUMBULL T ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY
PLAINVILLE, CONN.

Bank of 12 Transformers
Total Capacity 4000 KVA
Electrical Contractor:
RIGGS DISTLER & CO., INC.
Philadelphia, Pa.

Piasecki Helicopter Corporation, makers of two of Uncle Sam's most important helicopters—the 14-passenger Air Force Work Horse, and the 6-seat Navy HUP—has installed Marcus dry type Transformers to do the vital power job in their big new plant at Morton, Pa.

They were selected because every detail of the Marcus dry type transformer is engineered for long life . . . and continuous, trouble-free performance. Latest contribution pioneered by Marcus for greater transformer durability is Hi-Heat, Hi-Dielectric Magnet Wire, insulated with DuPont's newest miracle polyester film "*Mylar*," combined with Johns-Manville "*Quinterra*" to reach insulation levels at least 10 times present industry standards.

Capacities from 1 to 3000 KVA

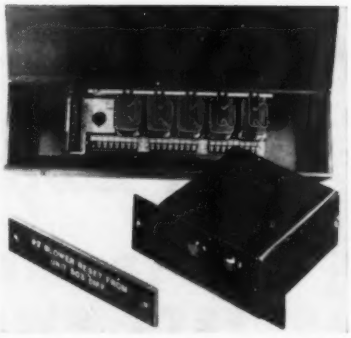
- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING
- SPECIAL

"Mark of Quality"

MARCUS
TRANSFORMER CO., INC.
HILLSIDE 5, NEW JERSEY

Representatives in Principal Cities

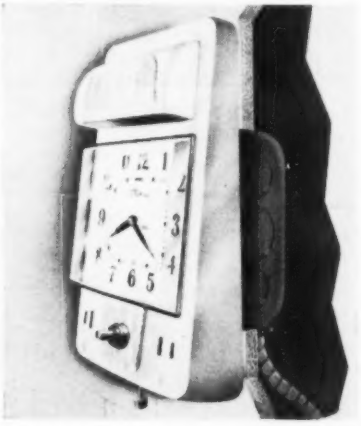
ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DRY TYPE TRANSFORMERS EXCLUSIVELY



Remote Signal Unit (26)

A new adapter unit which permits remotely located visual trouble signals to operate as part of a common, plant-wide audio-visual annunciator system. For the remote visual signals, either individual backlighted, illuminated nameplate units or bullseye lamps are furnished. They may be used for scattered locations on panelboards or operating locations in the plant. Bullseye lamps may also be used with separate ON-OFF lights to form a three-light control station. All signals connect to a common horn or bell. All moving parts and contacts are enclosed in hermetically sealed plug-in units which are corrosion-proof and suitable for Class I, Division 2 locations. Additional signals may be added to the system. Adapter cabinet is pre-wired for all standard audio-visual sequences.

Panalarm Products, Inc., 6312 North Broadway, Chicago 40, Ill.



Clock (27)

A built-in electric clock called the "Tel-in-Wall". It provides two outlets where other electric appliances can be plugged in and it also has a night light. Clock is easily installed over a standard four-inch wall box and shows no cord of its own. By its two outlets, however, it can supply current simultaneously to a heater, electric razor, toaster, coffeepot or, almost any electric appliance. A 7-watt bulb under a hood at the top gives light at night. It is designed of white plastic and when installed, it is semi-flush with the wall, projecting $\frac{3}{8}$-in. at top and $1\frac{1}{8}$-in. at the bottom. It is $7\frac{1}{8}$ inches high by $4\frac{7}{8}$

inches wide. Clock runs on self-starting synchronous Telechron motor. It operates on any 110-125 volt ac. Outlets are rated at 15 amperes, 125 volt.

Telechron Department, General Electric Co., Ashland, Mass.

Weatherproof Socket (28)

A new all rubber, weatherproof socket, primarily for outdoor use. It features a tough, all rubber, watertight construction designed for heavy duty work. Made with No. 14 Type R, U.L. approved wire, (1 lead white and 1 black) with ends stripped 1 inch for easy connection. Has a nickel plated screw shell and bakelite washers. Extended lip presses onto glass of bulb when screwed into socket. Wire enters socket body through rubber watertight sealing boots. Rated at 660 watts-250 volts. Listed by Underwriters' Laboratories, and carries CSA approval.

Eagle Electric Mfg. Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.

Pressure Switch (29)

A new type precision pressure switch suitable for use on water, air or hydraulic pressures. Switch is an adaptation of the Bourdon Tube principle, with no wearable moving parts. High and low pressure limits can be adjusted independently to any range within 100 lbs., including fractions of an ounce. For pressures over 100 lbs., an interchangeable unit can be installed with a single screw. Operation cannot be affected by oil or abrasives such as scale, sand or lime. A special snap-action contact unit has a life expectancy of 1,500,000 operations. Rating of 110 volt, ac, ½ hp, and can be used as a control up to any hp. Entire weatherproof unit measures 3 inches in diameter by 2 inches.

Simple Manufacturing Corp., 214 Temple St., Syracuse, N. Y.

On-the-job photo,
Ace Day & Night Electric Co.

"60% man-hour savings...15 to 20% materials' savings with Greenlee Hydraulic Bender"

Here's how you trim costs immediately with a GREENLEE Hydraulic Conduit Bender on the job. It saves man hours. It saves materials. It speeds and smooths up the installation in several ways.

This has been proved over and over again through experiences such as reported by Ace Day & Night Electric Co. of Inglewood, California. When they recently used a Model 770-T to bend 1-1/4", 1-1/2" and 2" tubing for installation in the Los Angeles Exposition Building, they commented as follows:

"About 60% savings in man hours by the use of the GREENLEE Bender. Elimination of material spoilage results in additional savings of 15%. Also, a saving of approximately 5% through not requiring fittings. And using the bender eliminates need for *any* manufactured bends."

Let the GREENLEE Bender make important savings on your jobs, too. With it *one man* quickly makes smooth, *accurate* bends in pipe and conduit up to 5", thin-wall conduit, tubing, bus-bars. Compact, portable . . . easily carried to the job and set up exactly when and where needed. Write for facts today. Greenlee Tool Co., 1745 Columbia Avenue, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

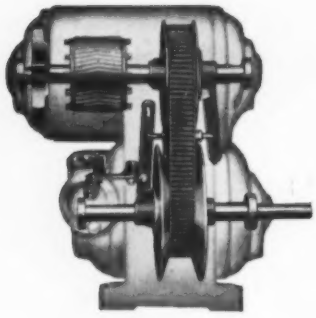
OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Knockout Tools • Auger Bits and Drills • Cable Pullers • And Many More

Variable Frequency Alternator Powered By Speed-Trol

Speed-Trols are being used as the drive on our variable frequency induction alternators because they provide the infinite speed variation, wide speed range and positive adjustment of pulleys required to assure accurate frequency selection over a wide range with a high degree of uniformity at any selected frequency, reports Mr. Zonne of American Electric Motors, Inc., Los Angeles.

STERLING SPEED-TROL



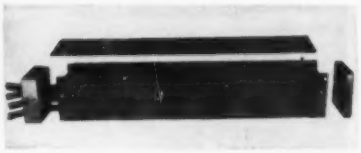
OUTSTANDING FEATURES:

Infinite speeds—positive speed regulation—fingertip control—large indicator—positive pulleys—no springs—belt tension in proportion to load—protected—streamlined—Herringbone Rotor—through ventilation—versatile mounting—NEMA dimensions—shock absorbing—quiet operation—rugged—compact—dependable—long life.

20-page illustrated catalog... Sterling Speed-Trol, Slo-Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. 1-B-416.

STERLING ELECTRIC MOTORS

Plants: New York City 51; Van Wert, Ohio; Los Angeles 22; Hamilton, Canada; Santiago, Chile
Offices and distributors in all principal cities



Wireway (30)

A new type of wireway designed to speed and simplify installation. On the cover, only two screws are required to fasten the cover to any one section. All other cover fasteners are of the lock type. Sections are joined by connectors, tees and elbows. Connectors and other fittings have a removable face plate which permits wires to be laid in after completion of wireway installation. Straight sections are available in lengths of one, two, three, four, five and eight feet, all in four cross-sectional sizes—4 by 4, 4 by 6, 6 by 6 and 8 by 8 inches. They are approved as auxiliary gutter and wireway by Underwriters' Laboratories, Inc.

Trumbull Electric Department, General Electric Co., Plainville, Conn.

Lighting Unit (31)

A new weatherproof lighting unit designed to meet the needs for a flexible indoor-outdoor fixture. It carries Underwriters' Laboratory approval and can be used with either "spot" or "flood" lamp. It is offered with a choice of a self-supporting universal mounting bracket that fits any standard floor, wall or ceiling outlet, or with a special "spike" for ground mounting. Unit takes all medium base, sealed beam type lamps and comes complete with a six-foot heavy-duty cord and plug. Unit can be used for a wide variety of home, store, and plant lighting needs.

Lightscapers, a division of Shalda Manufacturing Co., Burbank, Calif.

Air Conditioners (32)

A new line of room air conditioners which draws the air to be conditioned through front grille, and cool, dehumidify, and filter it twice before releasing it into the room. It can be installed in a window with the grille projecting no farther than the line of the drapes. New design eliminates all air inlet and outlet grilles from the sides, top, and bottom of unit, completely enclosing and insulating it in a solid box of girder construction. It can be placed in a simple frame opening in the wall with only the grille showing inside the wall. Or it can be installed entirely inside the room with the back inlet fitted to the window or wall opening. The new line will offer 10 models. Window units will be in ⅓, ½ and 1 hp sizes, with thermostatic models in the two larger sizes. Console models will be in 1 and 1½ hp, plus a 1 hp and 2 hp console with water-cooled condensing where an outside air supply is not available.

Carrier Corporation, Syracuse, N. Y.

Rectifier (33)

A new germanium rectifying device to operate a dc motor direct from an ac power line. The new rectifier can be incorporated into industrial variable-speed motor drives. Among possible applications are motor drives for drill presses, engine lathes, centrifuges, and looms. Each tiny germanium rectifier in the new device is hermetically sealed. Devices will be produced especially to fit the requirements of specific applications. Ultimately, a line of units with standardized ratings will be produced.

General Electric Company, Syracuse N. Y.

Flanged Elbows (34)

Quicker electrical installations are possible with these flanged elbows. Available in 22½ and 45 degree bends, eliminating cutting or difficult fitting when used with 2½ inch, 4 inch or 6 inch square hinged cover wireways. Elbows are flanged at each end to permit easy assembly of wireway sections. They are made of heavy code gauge steel, finished in gray baked enamel.

Keystone Manufacturing Co., 23328 Sherwood Ave., Center Line, Mich.

MOISTURE DAMAGE!

More than DOUBLE the Life of Your Electrical Equipment with SAFE-T-SEAL

READ THIS CASE HISTORY!

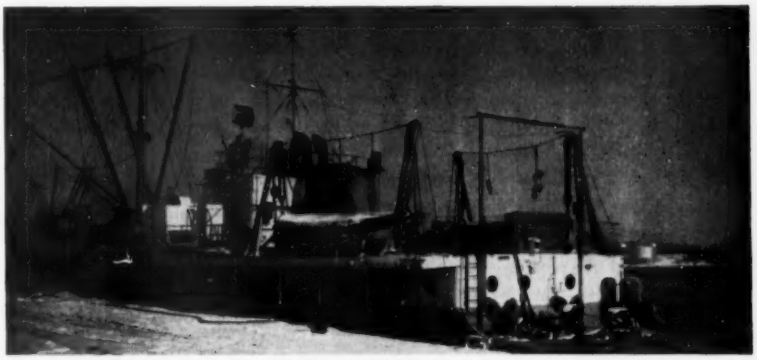
Mr. George T. White, Chief Engineer of the Freighter "Zebrinney" reviews the experience of Fishery Products, Ltd., as follows:

"Safe-T-Seal has effected a considerable saving in maintenance costs, down-time, and work stoppage since its application to important electrical control equipment on the freighter, Zebrinney.

"Four large Westinghouse panel boards, containing 230 volt DC contactors and switches, were subject to exceedingly heavy green corrosion from salt atmosphere and condensation. In spite of a constant maintenance program, which included cleaning every day, plus extra cleaning prior to loading or unloading, this equipment failed frequently.

"After processing with Safe-T-Seal, these boards have not had a single failure, even though the Zebrinney has operated continuously in the North Atlantic, under the same conditions as before. The entire boards, including the copper contacts, show no evidence of corrosion. Incidentally, since there was no corrosion, the cleaning of the boards was ceased after Safe-T-Seal treatment.

"Safe-T-Seal treatment has completely solved a serious moisture and salt atmosphere problem that had previously lacked a solution."



SAFE-T-SEAL is the amazing new impregnator for electrical motors and equipment that means money in your pocket!

It reduces down-time, prevents unnecessary work stoppages, helps eliminate idle man-hours. Guards against moisture, acids, salts, fats, fumes, alkalis, dusts and vapors of all types.

SAFE-T-SEAL is suitable for nearly all sizes and types of motors and other electrical apparatus. Easy to apply. Authorized service shops from coast-to-coast.

Cut Down-Time... Lower Maintenance Costs... Have Your Equipment Processed with SAFE-T-SEAL TODAY!

Write for complete information... NOW!

SAFE-T-SEAL DIVISION
THE CHEMAGNETIC CORPORATION
132 West Verdugo Avenue
Burbank, California

Please send me complete information about amazing new SAFE-T-SEAL.

I am interested in its use on _____ (type of equipment)

subject to _____ (damaging agents)

Name _____

Company _____

Address _____

City _____ State _____

People quit . . . they get sick . . . they don't show up! Jobs in a rush . . . Vacations . . . Itemized Billings . . . Fouled-up Purchase Records . . . Tax Problems—Yes, office routine jobs are a constant source of headaches to Contractors. Such conditions prevail from Maine to Texas, from the Atlantic Coast to the broad Pacific Shores with Contractors, large, medium and those just getting started in business.

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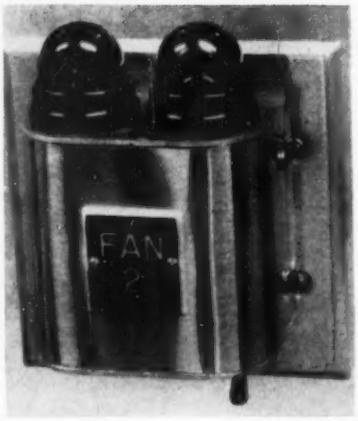


Annunciator **(35)**

Automatic annunciator service is supplied by this package wiring device unit called Vigilarm. Designed for flush or surface mounting on standard outlet boxes, it is a completely wired unit which needs only connection to the trouble contacts, the audible signal and to power. An abnormal condition of contacts under supervision illuminates both red and green lamps and sounds audible signal. Operation of toggle switch silences audible signal and extinguishes green lamp leaving red lamp illuminated. When contacts restore to normal the audible signal is automatically sounded again, the red lamp is extinguished and green lamp is lighted. Standard units are for 115 volt ac operation.

H. R. Kirkland Co., Morristown, N. J.

(36)

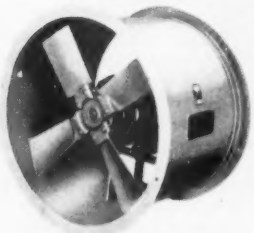
LIGHTING FIXTURE ensemble, called "Young Moderns". The series includes fixtures for every room. Each unit is a geometric form of washable white, linen-like Plexiweave, free-floating in a slim frame finished in jet wrought iron. Mesh-textured glass diffusers suspended within the fixtures eliminate glare, provide a soft flood of diffused general illumination. Two ceiling fixtures glide up and down on a concealed spring-triggered reel. A pin-up model raises, lowers, swings from side to side and plugs in like a lamp. Made by Lightolier, Inc., 346 Claremont Ave., Jersey City 5, N. J.

Ceiling Light (37)

A new design in incandescent ceiling light for the home, known as Futura, Cat. No. 1569. It is a one light unit made of brass with a fibre glass bowl 15 inches in diameter. Unit is suspended from ceiling 14 inches over all by means of a brass rod which attaches to and supports the glass bowl from the edge. It uses a 150 watt incandescent lamp.

The Glatthar Lighting Co., 949 East 72nd St., Cleveland 3, Ohio

Type PLFX



Power Line Direct DriveDuct Fan

Duct Fan (38)

Power line direct drive duct fan, Type PLFX is for factories, mills, mines and duct installations. Fan is built into a steel drum with rear and front mounted flanges. Motors are ball bearing, totally enclosed. Blades are non-overloading, made of cast aluminum. Recommended for temperatures up to 110° F. Available for higher temperatures. Sizes 16-in. to 48-in., 2900 to 37,500 CFM. Also available as Type PLDX, belt driven with motor and belt out of air stream.

Chelsea Fan & Blower Co., Inc., 639 South Avenue, Plainfield, N. J.

Bus Runs (39)

New metal-enclosed, isolated-phase bus runs, rated as high as 8000 amperes, 14.4 kv. They can be shipped in three-phase packages in lengths up to 16 feet. The extension of unit length from a previous limit of 10 feet to 16 feet and of rating from 6000 to 8000 amperes was accomplished by using aluminum conductors. Electrical joints between aluminum conductor sections are silver surfaced. This

Install SAFE* ALL-ELECTRIC ELECTROMODE HEAT

HARD-TO-HEAT AREAS
FACTORIES
OFFICES
ISOLATED BUILDINGS
PUMP HOUSES
METER HOUSES
WATCHMAN HOUSES
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LOBBIES
STORAGE ROOMS
GARAGES
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MORE PROFIT FOR YOU

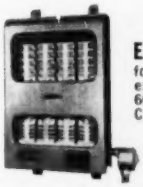
- QUICK, EASY TO INSTALL
- MINIMUM MAINTENANCE
- 100% EFFICIENT
- USER SATISFACTION

*SAFE Only Electromode has the completely sealed-in, cast-aluminum heating element. No danger of fire, shock or burn. Built-in safety switch prevents overheating.

ECONOMICAL All current entering the unit is converted into heat. There is no heat loss en route, like there is with long steam pipe runs. This system cannot freeze. The heating element will not rust, corrode or deteriorate. For utmost economy, can be thermostatically controlled.

COMBINATION PORTABLE and SUSPENSION type
models, 1500 to 7500 watts (5,122 to 25,613 btu). Adjustable louvers permit directing heat into working zone. Model AN-30A illustrated.

SUSPENSION TYPE MODELS
available from 10,000 to 45,000 watts (34,150 to 153,675 btu). Adjustable louvers permit directing heat into working zone. Model 14-10 illustrated.



EXPLOSION-PROOF HEATERS
for heating hazardous areas subject to explosion. In three sizes: 2000, 4000, 6000 watts (6830 to 20490 btu). Model CX-2 illustrated.

AUTOMATIC WALL-TYPE HEATER
with Down-Flo principle distributes clean, healthful, fan-circulated heat at floor level. Available from 1500 to 4000 watts. Model WA illustrated.

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We are interested in ☐ Electromode Industrial Heaters
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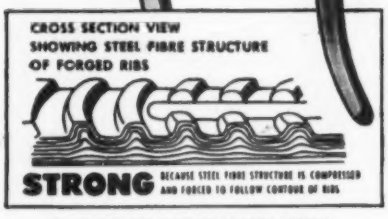
Full forging of the rib joint is the secret of this new UTICA pliers. Forging makes the steel fibre structure follow the contours of the ribs as shown in the diagram below. Hence, each rib shares the sinew-like strength of the entire joint.

Be sure you see these new pliers! One look, one "heft", and you'll know they are "UTICA® quality."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SHOWING STEEL FIBRE STRUCTURE
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BECAUSE STEEL FIBRE STRUCTURE IS COMPRESSED AND FORCED TO FOLLOW CONTOUR OF RIBS

IT PAYS TO USE QUALITY TOOLS
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insures a bond between the silver and aluminum for permanent low resistance joints.

General Electric Company Schenectady 5, N. Y.

Concrete Saw **(40)**

A new concrete saw called "Consaw", which can be taken to the highway, street, runway or any other kind of concrete or asphalt surface. Some of the features are—three point "no bind" wheel suspension which holds the blade straight and true in the cut. Using four rubber wheels for solid support, there is no twisting or drifting while cutting irregular surfaces. Water application supplies coolant to the cutting edge. Adjustable depth lock allows setting the desired depth of cut and blade stops automatically at this level. Positive screw feed permits raising or lowering blade into the cut. There are five models, both electric and gasoline.

Clipper Manufacturing Co., 2800 Warwick, Kansas City 8, Mo.

Product Briefs

(41) Porcelain insulator cleaner removes dirt and grime from insulators. Manufactured by Leo R. Leary, Buffalo, N. Y.

(42) Manco Manufacturing Company, Bradley, Ill., has announced the development of a new **cutter** in their hydraulic Guillotine line for the cutting of angle iron. . . . (43) A new **aerial tower** unit designed to give a man a 100-foot reach has been built by Mobile Aerial Towers, Inc., Fort Wayne, Ind. . . . (44) Blonder-Tongue Laboratories, Westfield, N. J., has introduced a laboratory-engineered variable TV **attenuator** which provides precise attenuation ranging from 0 to 42 db., in 6 db. steps, over the entire VHF band.

(45) A new 400-ampere single-phase ac welding **transformer** with a 60% duty cycle has been announced by General Electric Company, Schenectady, N. Y. . . . (46) Marion Electrical Instrument Co., Manchester, N. H., has announced a new HM2ET elapsed **time indicator** designed for installation where panel space is limited. . . . (47) A weatherproof high power **loudspeaker** that is designed to resist salt spray or actual immersion in salt water is made by C. C. Galbraith & Sons Electric Corp., New York, N. Y.

(48) Thermo Instruments Co., Belmont, Calif., has developed a new electronic liquid level **control** . . . (49) A new portable **flag standard,** incorporating design features suggested by "on-the-job" highway workers and repair crews, is being manufactured by the Charleston Rubber Co., Charleston, S. C. . . . (50) Anco Instrument Division, American Name Plate & Mfg. Co., Chicago, Ill. has introduced a new audio-video model of the Elec-Detec, portable **electronic instrument** designed for locating noise sources in all types of mechanical equipment.

(51) Anthony Co., Streator, Ill., has added a 4,000 lb. capacity model to its **lift gate** line. . . . (52) A complete line of the new EEI-NEMA standard distribution **fuse links** that are electrically and mechanically interchangeable with other makes of EEI-NEMA standard fuse links has been announced by General Electric Company, Pittsfield, Mass. . . . (53) A new all-metal **electric spray gun** for a wide range of industrial uses has been announced by the Waldorf Sales Co., Yonkers, N. Y.

(54) A new clamp-on weatherproof **lampholder** has been announced by the Afco-Lite Corporation, Chicago, Ill. . . . (55) Atlas Industrial Corporation, Brooklyn, N. Y., has introduced a new **Scaf-Fold** for all overhead maintenance such as painting, lighting, cleaning, etc. . . . (56) A new type of Jiffylite **lamp reflector** that screws into any standard light socket has been announced by the Abolite Lighting Division, Jones Metal Products Co., West Lafayette, Ohio.

(57) The new C-502 **oil burner** controller announced by Iron Fireman Manufacturing Co., Cleveland, Ohio, offers special protection for oil-fired heating equipment, as well as automatic control of operation. . . . (58) Beaver Tool Company, Huntington, L. I., N. Y., has developed a new **drill extension rod** and chucks fitting over 52 small diameter drills. . . . (59) Flashlight **bulbs** which, at the flip of a switch, throw either a flood or spot of light, have been developed by General Electric's Lamp Division, Nela Park, Cleveland, Ohio.

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You can trust it...

These Circle F wiring devices meet all federal specifications, and all requirements of the REA and CSA. They have earned approval of the Underwriters Laboratories.

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Circle F means wiring devices manufactured from the best grade of materials—by skilled labor—and thoroughly tested and inspected. You know you're selling the best when you sell Circle F.

No. 2035
If you want a small, compact switch that really stands up, get this all bakelite, Flush Toggle Switch with box screws mounted in ears. Single pole, brown or ivory. Easy to install. Wide ears are scored. 5A-250V—10A-125V. [T]

No. 9101
Perfect if you want a Flush Toggle Switch for extra rugged use. All bakelite—totally enclosed—top wired—has positive kick off. Brown or ivory. Also in three way. 5A 250V—10A-125V [T].

No. 109
Ideal if you want a flush duplex, T-slot receptacle with plaster ears that is quickly installed. Box screws mounted in ears. All bakelite body in brown or ivory. 10A-250V—15A-125V.

No. 136
You'll find this Duplex Flush Receptacle easier to install because box screws are mounted in ears—binding screws are backed out. Wide ears are scored. All bakelite—brown or ivory—double contacts. 10A-250V—15A-125V.

Write for our new Catalog No. 18

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GUARANTEED F WIRING DEVICES

HERE'S FULL-TIME PROTECTION FOR TEMPORARY CIRCUITS

For temporary circuits needed in construction work and other outside jobs, the Heinemann "Receptacle-Type" Outdoor Service Unit provides on-the-spot power with full circuit protection.

Combining convenient utility with absolute protection, this Heinemann Outdoor Service Unit has wired-in receptacles for tools, pumps, floodlights and other equipment. It's a portable, fully protected service unit that can be carried from job to job . . . without makeshift arrangements. The only connections needed are those directly to the line.

As Heinemann Circuit Breakers employ no thermal elements, current capacity of the unit is not affected by summer or winter temperature extremes—an especially important feature in outdoor equipment.

Should a fault in the line trip the breaker, the user restores current simply by switching the handle to the "ON" position. There is no confusing reset position . . . no need for the power company to make extra service calls.

"Receptacle-Type" Outdoor Service Units are housed in rugged, weather-proof enclosures which may be padlocked to prevent tampering. Plug-in receptacles are on the bottom. Also available with spring-hinged door to enclose receptacles when not in use.

For complete details, write for Bulletin 2013

HEINEMANN ELECTRIC CO.
132 PLUM STREET • TRENTON 2, N. J.

HEINEMANN Circuit breakers

(60) Modernization of the electric **motor frames** in the higher horsepower ratings of the T-type design has been announced by Electro Dynamic Division, General Dynamics Corp., Bayonne, N. J. . . . (61) A new hydraulic **extension ladder** suitable for maintenance or service work at high levels in factories, foundries, aircraft hangars or assembly plant has been introduced by J. H. Holan Corporation of Cleveland, Ohio. . . . (62) Two new series of **toggle switches** that conform to AN and JAN specifications have been announced by the Micro Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

(63) Hardwick, Hindle, Inc., Newark, N. J., has developed three new higher wattage **rheostats**—H-75, H-100 and H-150. . . . (64) A new **splice** that requires conductors to feed through the jaws has been developed by Reliable Electric Co., Chicago, Ill. . . . (65) Multi-flange **coil bobbins** are now available in any size and shape from the Precision Paper Tube Co., Chicago, Ill.

CATALOGS and BULLETINS

(66) CONTROL RELAY designed for remote control of multi-motor machines, solenoids, temperature or pressure regulation circuits, etc., is introduced in illustrated booklet showing construction features, dimensional data and associated wiring circuits. Westinghouse Electric Corp.

(67) FEEDER VOLTAGE REGULATORS are described in manual covering their installation, operation and maintenance and including schematic and wiring diagrams and tables for calculating setting of compensator. Allis Chalmers Mfg. Co.

(68) FLUORESCENT LUMINAIRES of all-steel louver-type design suitable for commercial applications and available in both four- and eight-foot units with two or four lamps are described in two new bulletins. Mitchell Mfg. Co.

(69) INCANDESCENT LIGHTING FIXTURES are illustrated in two new folios. A 2-color 16-page folio lists over 30 different fixtures suitable for commercial and institutional interiors, while a 4-page folio describes luminaires in nautical, rustic and classic motifs. Gruber Lighting.

(70) METALLIC RECTIFIER power conversion units rated from 125 to 250 volts dc are presented with illustrations, performance curves, schematic

diagrams and applications data in 8-page bulletin. General Electric Co.

(71) WIRING DEVICES including outlets, receptacles and switches of many types suitable for residential use are described in a new booklet and illustrated with architectural plans showing their application. Arrow-Hart & Hegeman Electric Co.

(72) INDUSTRIAL HEATERS of the heavy-duty centrifugal fan type for large-area heating are listed in 32-page catalog with application and performance data, information on estimating heat loads, typical specifications and examples, dimensional data and installation instructions. Westinghouse Electric Corp.

(73) INDUCTION MOTORS of dripproof design from ½ to 150 hp are described in a brochure with dimensions and specifications, speed torque curves, frame number charts and information on optional mounting and special purpose applications. Lima Electric Motor Co.

(74) SPECIAL-PURPOSE VOLTMETERS are described in two catalog sheets. The first, a Touch Voltmeter for use on circuits of 20 kv maximum to ground, is used to indicate the presence of a voltage on a conductor by touching conductor. The second, a Phasing Voltmeter which provides a testing means for paralleling 3-phase voltage circuits, has two ranges of 9 and 36 kv. Western Electro-Mechanical Co. Inc.

(75) SERIES MOTOR PARTS are covered completely in two 12-page bulletins with illustrations, rating and dimension charts, curves, formulas and discussion of design and application problems. General Electric Co.

(76) STARTERS AND CONTACTORS in various styles for direct mounting on motors in sizes up to 10 hp at 220-440-550 volts are described in 4-page bulletin. Furnas Electric Co.

(77) AC VOLTAGE REGULATORS which control line voltage electronically are illustrated and described as to electrical and physical specifications in a 16-page catalog which also presents a discussion of electronic regulator circuit operation. Sorenson & Co., Inc.

(78) SECTIONAL SCAFFOLDING of aluminum is discussed in a folder which illustrates structures possible with the various ladder and rolling types of sections. Patent Scaffolding Co., Inc.

(79) ELECTRONIC PYROMETER CONTROLLERS of new plug-in construction

GE WATER COOLERS

IF YOU SERVE COMMERCIAL OR INDUSTRIAL CONCERNS—handle their new construction, remodeling work or maintenance—you can increase your earnings with little extra effort by selling G-E Water Coolers to your regular customers.

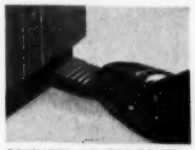
NO STOCKING. Your G-E wholesaler maintains complete stocks of G-E Water Coolers and delivers them when and where you want them.

NO SPECIAL SALES TRAINING REQUIRED. G-E Water Coolers are easy to sell, and your G-E wholesaler has all the sales tools you need.

5-YEAR PROTECTION PLAN! Every G-E Water Cooler is backed by the generous 5-Year Protection Plan. "Over-the-counter" replacement simplifies service.

GET THE FACTS NOW—start earning extra income without extra overhead. Send in the coupon, or phone your nearest G-E wholesaler. He's listed in the classified directory under "Water Coolers."

SANITARY STAINLESS STEEL TOP. No seams or crevices to harbor dirt and germs. • No squirt, no splash, no spill.



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General Electric Company, Section EC-6
Air Conditioning Division, Bloomfield, New Jersey

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VAP-OIL-TITE FITTINGS

Fouled contacts cause costly burnouts and down-time. Use VAP-OIL-TITE FITTINGS with Plastic Covered Flexible Metallic Conduit for Sure Sealing of wiring on oil, water, dust and vapor tite equipment.

VAP-OIL-TITE'S exclusive threaded bushing not only insures positive grounding but also makes fitting easier to install because a collar covers metal edges making burring unnecessary. Furnished in numerous types with body sizes from 3/8" to 2". Write or wire today for bulletin #MT-104 giving types, sizes and prices.

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Fixture mounts on any existing 2" pipe Standard or furnished with Tapered Pressed Steel Poles . . . or with Air and Water Facilities.

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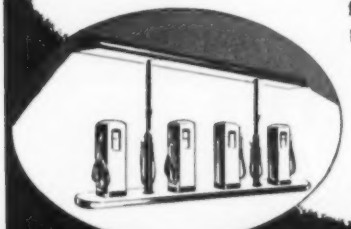
The only Fixture on the market that permits mounting Cluster Lights at any elevation above fixture to avoid glare.



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4' or 8' Fixtures or continuous combinations to suit any size Island

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INDOOR AND OUTDOOR LIGHTING FOR EVERY NEED

for various combinations of control are introduced in a bulletin with complete specifications and full-size reproductions of actual temperature scales. Bristol Co.

(80) LIQUID LEVEL CONTROL using single thyratron tube and capacitive-type probe with no moving or contact-making parts is described with specifications and illustrations in new folder. Thermo Instruments Co.

(81) FLUORESCENT LUMINAIRES of two basic units are combined to form long unbroken runs, squares or rectangles, cross or T-construction, or S- and U-shapes. Bulletin furnishes lighting calculator to determine number of units needed for any installation. Metalcraft Products Co.

(82) ELECTRIC MOTORS, parts, miscellaneous accessories and equipment are described and illustrated with specifications and prices in new catalog. Harry Alter Co., Inc.

(83) TRACTION DYNAMOMETER with capacities of 0-500 up to 0-100,000 pounds is described in 6-page bulletin with dimensional data, prices and illustrations showing typical uses. W. C. Dillon & Co.

(84) DIRECT CURRENT GENERATORS of capacities up to 300 kw and available as either single or two bearing units for coupled or belt drive are illustrated in new catalog with details of construction for field coils, armature and other component parts. Columbia Electric Mfg. Co.

(85) VACUUM SWITCH designed to guard industrial equipment such as electric or gas motor-driven pumps against breakdown due to dry operation or vacuum chamber leak is described and illustrated by cutaway photos and detailed hook-up drawings in new literature. Jaycon Associates.

(86) SELENIUM POWER RECTIFIERS for elevator applications and selenium surge suppressors for protection of such industrial equipment as motor-generator sets, alternator fields and electromagnets against self-induced voltage surges are discussed in two 4-page bulletins. Accurate Engineering Co.

(87) GENERAL-PURPOSE STARTERS for squirrel-cage induction motors rated up to 600 hp at 600 volts or less are illustrated in new bulletin together with explanation of two- or three-wire control, information on selection of starters and heater elements for overload relays, and a cage motor starter selection chart. Allis Chalmers Mfg. Co.

SORGEL
AIR-COOLED Dry-Type TRANSFORMERS

for Every Purpose

¼ to 1500 Kva single phase. 1 to 3000 Kva poly-phase.
All voltages up to 15,000 volts.

Custom Built Transformers

Complete with enclosures, tap changing switches, circuit breakers, fuses, meters, etc.

Or without enclosures for unit substations, power centers, panel mounting, or for installation with other equipment.

Reactors D.C. Saturable

To regulate the voltage and current of any manufacturing process.

The control can be a small, simple potentiometer, with stepless adjustments, or push button control, placed in any desired convenient location.

Ask us to help you work out your requirements.

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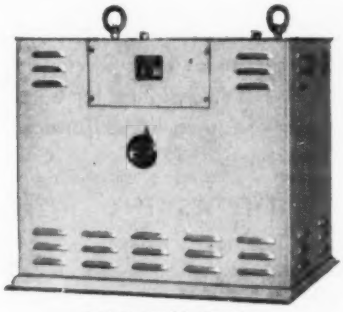
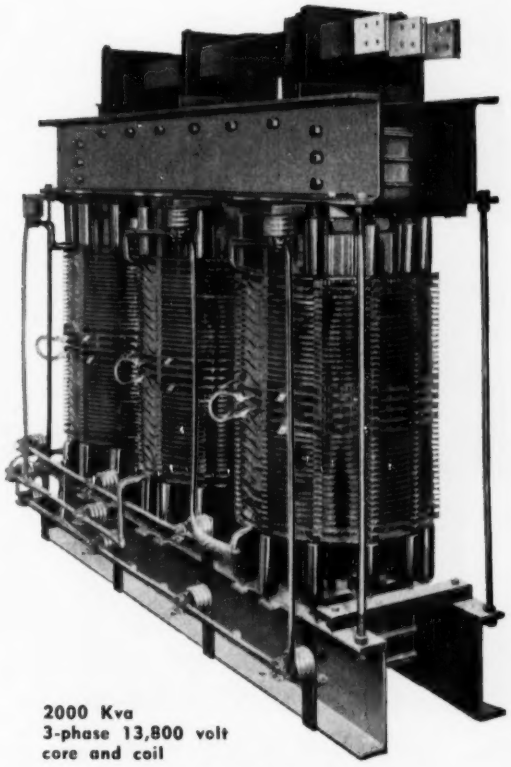
General
Purpose
Transformer



D.C. Saturable Reactor
with potentiometer control



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3-phase 13,800 volt
core and coil

for Unit Substations

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Receptacles . . . Caps
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"A Turn of the Cap and It's Locked"

USE P&S TURNLOK — wherever the uninterrupted flow of electrical current means TIME SAVED — MONEY SAVED — INCREASED SAFETY. Designed for quick, easy wiring — with added safety features — P&S Turnlok will give years of trouble-free service.

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The new 8-page descriptive manual with complete illustrations, dimensional and catalog information. Just drop us a line on your letterhead.

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Reader's Quiz

Automatic Transfer Switch

QUESTION W22—We had a condition on running a vertical deep well pump on a cooling tower basin that I am at a loss to explain completely. Possibly some of your readers could help me. The motor on the pump is a 100 hp 440 volt squirrel cage induction motor fed by a 200 amp circuit breaker and a conventional magnetic motor starter. The motor is started by momentary contact pushbuttons.

The motor is normally fed from the power company, but it has an automatic transfer switch that will throw the motor over on a 1000 kw diesel generator in the event of power failure. The transfer switch was manufactured by the Automatic Switch Co., 400 amp. Bul. No. 908 Serial No. B18087. It transfers automatically from the power company to the diesel, but to transfer back to the power company a reset button must be pushed. The unit was tested by switching off the normal power which threw the pump onto the diesel. The transfer to the diesel worked smoothly, but part of the time when the transfer switch was thrown back to the power company the pump made a noise as if it was cross phased and the 200 amp. breaker feeding it was tripped out. Most of the time the transfer was fast enough in both directions that the magnetic contactor did not fall out. Also the diesel was not synchronized with the power company.

I would be interested in knowing if other places have had this type of trouble with automatic transfer switches.—O.B.T.

ANSWER TO W22—A situation somewhat similar to the one you write about confronted us recently. An industrial customer was fed by the power company through a 22 kv transformer bank and the customer's 440 breaker. During light load periods, the customer was forced to run at low power factor which tripped his breaker, due to the settings of various relays, causing unnecessary outages whereby it necessitated transferring the load to his generator. When the load picked up and normal running order was to be established, trouble developed because of the reactive power feed in the reverse power relay and no synchronization of the load. To remedy this, the phase angle of the reverse power relay was changed to bring about a better power factor and the load was synchronized using a voltage relay capable of synchronizing as any cross-phasing would produce a voltage in the relay to trip the breaker.—J.B.K.

How to Check Motor Trouble

QUESTION X22—How can I protect a 5 hp, 3 phase, 230 volt motor that is used to drive a laundry extractor? It takes almost three minutes to bring the load up to full speed. Then the motor draws about 11 amps. The motor has to be started every ten minutes.—H.S.

ANSWER TO X22—The only way you can protect this motor is to find and eliminate the cause of the long starting period. After this is done the overload relay heaters supplied with the equipment should hold it o.k. Assuming that the motor in question is a high slip type 4 motor with a double bar squirrel cage rotor or else a type 7 motor with a high resistance squirrel cage rotor, a 5 hp extractor should come up to full speed in one minute or less. Three minutes is too long for the motor to have to stand the high starting current. Also, these machines are always rated in starts per hour, with four or five starts being usual. The fact that your running current is only 11 amperes leads me to believe that your line voltage is low or else the machine is being overloaded which would cause a heavy drag at the start but roll easily after getting up to speed. A procedure similar to the following will enable you to get at the root of your trouble.

1. Check the wiring, wire sizes, connections, lugs, contacts, etc., test voltage and current on all 3 phases at the motor as well as at entrance switch. How is the voltage drop? A great deal of laundry machinery is made for 199 or 208 volts and power is supplied accordingly. If you have a low voltage supply a 3 phase autotransformer might be cheaper and easier than changing to a low voltage motor.

2. Compare with other extractors if there are more than one in operation. Check acceleration time with no load; most machines will attain full speed in about 45 seconds when empty. If it does not do so; a. Be sure the brake is releasing and there are no accumulated strings, lint, etc., causing it to drag. b. Check the machine bearings in the usual ways for noise, heat, etc. Be sure they have the correct grade of grease in them. c. Block the brake so it cannot work, bring the machine to full speed, and check the time it takes to coast to a stop. Compare with identical machines if possible. This is the best possible field test on machine bearing condition, and if they show to be good the trouble is in the motor.

3. If extractor accelerates quickly when empty but not when loaded check the amount of load that is being put into it. Weigh it and compare with the name plate specifications. It takes only a few pounds of overload to make a serious difference, and operators are prone to overload them most of the time.

4. If the number of starts per hour is more than specified for the motor, it is bound to be damaged eventually. This can best be prevented by installing a timer to keep the machine running long enough for the motor to cool off between starts. In some cases it may be practical to install a small blower to cool the motor but this is not usually recommended practice.—J.H.B.

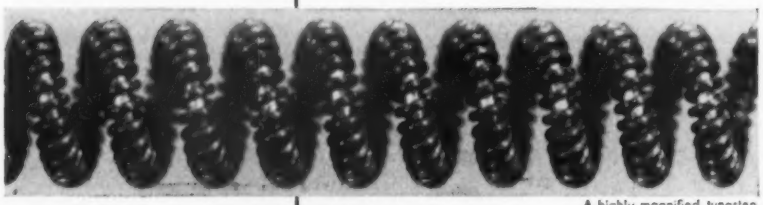
Motor Operation

QUESTION Y22—What percent of increase in amperes could be expected in a motor as it rises in temperature? We have a 300 hp pump motor which runs normally, trouble free, until a sultry day increases the heat to the extent that the breaker opens. The thermals are for 67 amperes, full load. I increased these by adding jumpers of number 22 wire. This did not entirely eliminate the shut-downs, so forced air was used, which eliminated shut-downs.—E.S.H.

ANSWER TO Y22—A thermal cut-out should disconnect a motor at a temperature which is below critical. If the motor temperature exceeds this critical limit, its insulation will rapidly deteriorate and eventually fail. The

Heart of a Champion

FACTS OF LIGHT



A highly magnified tungsten coil on a mandrel.

TUNGSTEN

99.99% chemically pure tungsten makes up the heart of a Champion. There's nothing better than tungsten for lamp filament use, at any price.

Asbestos, or even fire brick, would melt at the 5000° glowing temperature of a tungsten filament within an incandescent lamp. The melting point of tungsten is 6120° F—that of iron is but 2800° F.

Tungsten oxidizes so rapidly that the oxygen content of one drop of water distributed evenly over 500,000 lamps would cause early blackening of all of them.

A 6 watt lamp filament is made from tungsten wire drawn to a diameter of .00047 inch — about 1/7th of the diameter of a human hair. A variation of five-millionths of an inch can affect filament life as much as 25%.

Backing up the heart of a Champion are long years of production experience. Carefully selected Champion electrical and industrial suppliers — there's one in your vicinity — assure you of the utmost in lighting value and service when you specify Champion lamps.

May we mail you a copy of this new booklet A, CHAMPION QUALITY, containing many other facts about lamps?

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

operating temperature depends on two factors: The current which the motor draws and the consequent I^2R loss; and the ambient temperature, that is, the temperature around the motor. The sum of ambient temperature and temperature rise over ambient caused by the I^2R loss gives the operating temperature.

It follows that a motor may operate satisfactorily at normal ambient and at normal current without operation of the thermal cut-out. On hot, sultry days, however, the ambient temperature is high, and this high ambient in conjunction with the normal temperature rise from normal I^2R losses, gives now an operating temperature above critical. The cut-out will operate and protect the motor insulation from becoming overheated. Application of forced air will not lower ambient. Hot air blown against the motor on a hot day is still hot air, but it will transport the I^2R energy away from the motor, that is, it will lower the temperature rise from the losses. Result: The motor will not kick out.—L.F.R.

ANSWER TO Y22—A 300 hp motor drawing 67 amperes must be 2300 volt winding. You have proved the fault lies between the thermal and the motor. The motor draws slightly above the ampere capacity of the element (thermal). You no doubt have a loose connection on one of the phase lines between the thermal and the motor.

The fact you kept it going by blowing air onto the thermal, suggests to me, your motor is in need of an overhauling and cleaning of the grit and dust between the windings of the motor.

All thermals are rated 125% of the rate of the moter, yet when these sultry days come about, the 125% overload may not be sufficient to hold the motor on the line, especially if the motor has been several years in service. These thermals have lost their efficient calibration. These faults plus a possible loose connection on the control line could cause you to have a shut-down.—OC.

Identifying Leads

QUESTION Z22—We have several 5 hp 440 volt induction motors that have been damaged to the extent that all leads are broken off and now are unmarked. These are nine lead motors for 220/440 volt operation. How can we identify these leads without stripping the motor down?—W.P.R.

ANSWER TO Z22—The following description is a method of determining

the correct wiring sequence of a 3 phase motor that comes into the shop with the leads completely burned so that identification of the numbers is not possible. With this method it is not necessary to disassemble the whole motor.

Step One: Number the nine leads arbitrarily so that you will have a starting point.

Step Two: With an ohmmeter or similar device find the various coil sets. Assuming the motor is Y-connected, only three leads will show continuity. These are from the internally-connected Y. The remaining six leads belong to the three isolated sets of coils (see Figure 1).

Step Three: If the motor is Y connected follow this procedure:

a. Apply a reduced voltage (40-100 volts) across one of the sets of coils that is not in the Y. (Use Figure 1 as an example and put voltage across 6 and 7.) Read the voltages across the Y (from 3 to 4, 4 to 5, and 3 to 5). Pick the lowest of these voltages. (Assume that it is between 3 and 4.)

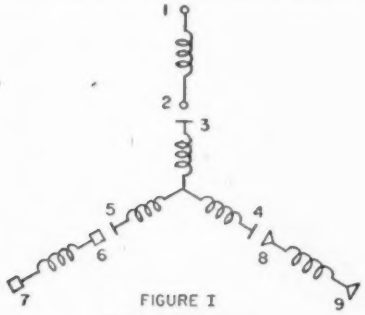


FIGURE 1
Y connected motor
220/440 volts
9 leads coming out

Denotes continuity as read by ohmmeter

b. The terminal of the Y that the volt meter is not attached to on the Y when this lowest voltage is read is the terminal that should be connected to the coil that is energized. In the example, since the volt meter is connected across 3 and 4 when the lowest voltage is read, terminal 5 should be connected to coil 6, 7.

c. It now remains to find out whether terminal 6 or 7 should be connected to 5 for the correct operation of the motor. First connect 5 to 6 and apply a reduced voltage to 3 and 7. Read the voltage across 6, 7. Now connect 7 to 5 and apply voltages to 3 and 6. Read the voltage across 6 and 7. The connection that resulted in the highest voltage across 6 and 7 is the correct connection.

Step Four: Repeat the above for the other coil sets.—R.P.S.

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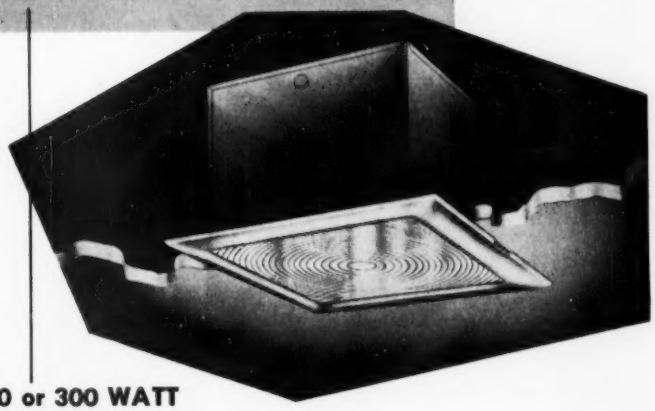

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Operator simply inserts any length of rod through the hollow handle. Rod is gripped near the ground by a heavy chuck. Downward blows of the handle against the chuck quickly drive the rod, the weight doing most of the work. Old rod may be easily pulled out of the ground by reversing this procedure.

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JAMES R. KEARNEY CORPORATION ST. LOUIS MO. 217

For Better Construction SAFER Maintenance

Determining Polarity

QUESTION A23—Is it possible to determine dc motor interpole polarity without removing the armature from the motor?—L.W.F.

ANSWER TO A23—If your motor is the old open frame type you can note which end of the needle is attracted as you approach the bottom of the interpole with a compass. If the north pole of the compass is attracted, the polarity of the interpole is south. Be careful to approach the interpole slowly as either end of the compass needle will be attracted if you get too close.

If the motor frame is only semi-open you can use the above procedure to determine the polarity of the main field pole, which, taking into account direction of armature rotation, is directly behind the interpole. Assuming that commutation is satisfactory the interpole of a dc motor will have the same polarity as that of the main pole directly behind it.—H.G.C.

ANSWER TO A23—In a dc motor without interpoles, the brushes are shifted against the direction of rotation to secure good commutating conditions. Interpoles or commutating poles are inserted midway between main poles to take care of this brush shifting. In dc motors the interpoles are placed ahead of the main poles with like polarity for both the interpole field and brush since the interpole winding is in series with the load current. Even if the direction of rotation reverses the interpole polarity also reverses so that it is still located ahead of the main pole and with like polarity.

For example, a motor with clockwise rotation would have a main north pole on top having positive polarity with a positive interpole and brush ahead of it still in clockwise rotation. The parameters that must be known are the direction of rotation and brush polarity or position and polarity of the main poles.

The converse of the foregoing applies to a dc generator.—J.B.K.

Use of Oscilloscope

QUESTION B23—What type of oscilloscope is best for servicing electronic circuits such as found in amplidynes, resistance welders, electric eyes and electrical polyphase circuits of 600 volts or less. It is not to be used for radio or television.—M.D.

ANSWER TO B23—The type of oscilloscope most useful for servicing your electronic circuits, will depend largely on the design of the cathode-

ray tube. As an example, for a deflection of one inch, approximately 130 volts must be applied to the deflection plates for a tube designed for an anode potential of 2000 volts. With a tube of 15,000 volts anode potential, 500 volts is needed for a similar deflection. Amplifiers incorporated in various oscilloscopes are needed to adjust the deflections when low voltages are to be studied. An oscilloscope, with the amplifiers incorporated for potentials of one hundred to about a thousand volts with unlimited frequency range to a certain value is the DuMont CRO Type 208-B.—J.B.K.

Can you ANSWER these QUESTIONS?

QUESTION P23—Why would high voltage lines continue to move up and down under certain weather conditions? This occurred only between one pole span. The rest of the line remained absolutely still. This condition continued for several hours.—E.S.H.

QUESTION Q23—We plan to change our 2400 volt delta connected system to 4160 volt Y system. Is there any advantage in running the neutral of the main supply bank to each primary of the 4160 to 480 volts Y-D transformers? No lighting transformers are used in this system.—M.D.

QUESTION R23—We have a portable dc welder, 300 ampere size which is driven by a 3 phase, 440 volt ac motor. The line to this 3 phase motor is a 312, 4 wire rubber cord. Occasionally the fourth wire, which is the equipment ground, gets very hot and burns the rubber insulation off.

Can any readers tell us why this ground wire burns.—H.W.

QUESTION S23—We recently purchased a milling machine on which was mounted an automatic plugging device. The motor is a 220/440 volt, 15 hp, 3 phase, 60 cycle ac, being run on 220 volts. The plugging device is connected electrically to T1 and T4 of the motor leads, and there are no mechanical connections from the device to the machine. However, when the motor gets down to a safe speed when stopping, the relays in this device throw in a plugging contactor and stop the motor. What is the principle of operation of this device?—S.R.U.

PLEASE SEND IN YOUR ANSWERS BY JUNE 15

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Insure consistent, reliable performance by specifying Paragon 300 Series time switches (shown above). They provide *proved* performance for controlling signs, commercial lights, stokers, burners, valves, motors or other equipment. As original equipment or replacements, they guarantee long trouble-free service with minimum adjustment. No wonder more and more contractors and wholesalers say "install a Paragon and forget it."

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something new
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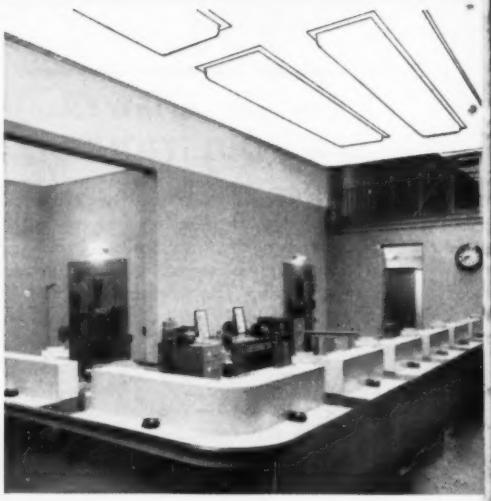

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1. recessed. Only the luminous Plexiglas is visible, depth 2½" from ceiling line.

2. surface-mounted. Variform luminaires hug the ceiling and blend in harmoniously. Depth only 6¼" from ceiling line.

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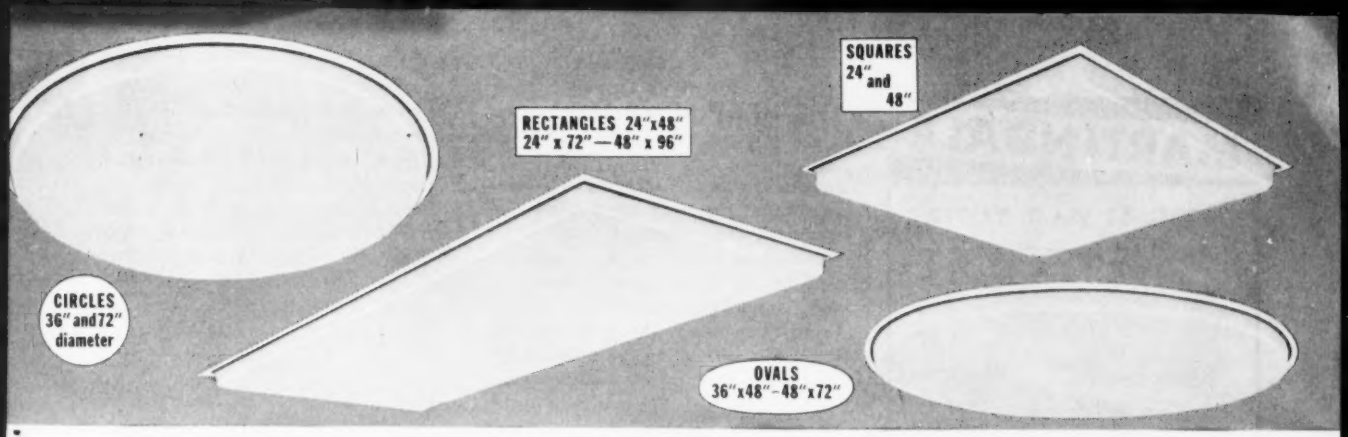
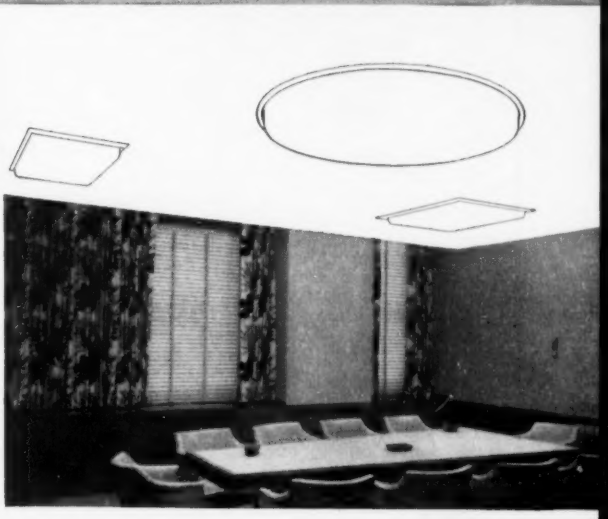
Everybody in the trade is talking about the LPI Variform. Beginning *now* an advertising campaign of double-page spreads is appearing in *Architectural Forum, Progressive Architecture,* and *Sweet's Architectural File*—PLUS a direct mail drive to 12,000 *electrical contractors* and 8,000 architects and electrical engineers.

Shown here is an exclusive and dramatic development in fluorescent lighting—a designer's dream come true! The Variform uses soft, lovely, molded Plexiglas—circles, ovals, rectangles, squares—in a choice of sizes ranging up to eight feet in length.

Think of the possibilities this offers your customers for original and harmonious arrangements. There is no limit to the beautiful effects you can achieve for a big edge in competitive bidding. Unit for unit, the Variform means more dollar volume for your customers—and a bigger profit for you.





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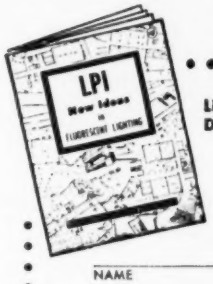
Variform shapes combine harmoniously with recessed troffers, incandescent down-lights and other standard equipment. Only standard straight fluorescent lamps are used.

Plexiglas absorbs less than 1% of luminous energy. Shatterproof, it will give many years of trouble-free service. Guaranteed not to sag, warp, lose shape or to discolor. Light in weight, easy to handle. Quickly cleaned with damp cloth, using mild detergent and water. Number of lamps used inside fixture is determined by degree of light output required.

mail coupon now for complete set of Variform drawings and specifications. You will also receive the latest LPI catalog, fully illustrated with photographs and drawings, "*New Ideas in Fluorescent Lighting.*"



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MARTINDALE

MODEL 52 V.A.O. TESTER

This new, sturdy, portable instrument has 5" meter,—Four testing ranges: Volts, AC and DC: 0-10.0-50, 0-250, 0-1000, AC only: 0-2.5: Amperes, DC only: 0-10; Ohms: 0-1000, 0-10000; Megohms: 0-1, 0-100. Selector Switch provides four positions: Volts AC, Volts DC, Ohms, Amps. Range Switch has 5 positions which provide for above Voltage ranges, 4 ohm ranges, and 1 ampere range. 4' test lead has both prods and alligator clips. Has sturdy, leather carrying case.

ADJUSTABLE BENCH GROWLER

Has adjustable jaws with face length of 2½". With jaws closed will test armatures as small as 1" diameter. With jaws open, will accommodate armatures as large as 18" diameter.

Available with or without meter. Also six other models.

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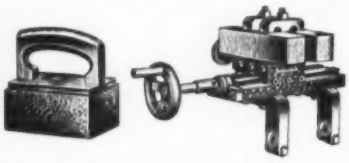

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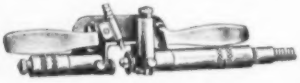

Nine Motor Driven Types

Write for New 64-page Catalog No. 29 describing these and many other products for industrial Maintenance, Safety and Production

MARTINDALE ELECTRIC CO.

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THE HEAT PUMP

[FROM PAGE 116]

are refrigerant; the heavy dotted lines are water; the light dotted lines are expansion valve equalizer lines.

In this variation, separate vessels are used for condenser and cooler. The water circuit is fixed: from source, through condenser, through cooler to drain. On the cooling cycle, the cooler is not operative; on the heating cycle, the condenser is not operative. On the cooling cycle, solenoid valves 1 and 2 are open, and 3 and 4 are closed. On the heating cycle, the exact opposite is true.

To trace the cooling cycle, start at the discharge of the compressor. Vapor passes through solenoid valve No. 1 into the condenser. There it is condensed to a liquid, which passes through the cross to the cooling expansion valve. Here the liquid is expanded down to suction pressure, passes through the inside coil, where it picks up heat from the air, and is vaporized. The vapor goes back through solenoid valve No. 2 to the compressor suction.

Notice the important part played by the cross. Because of the open cross, high pressure liquid exists at the point where the equalizer line from the heating expansion valve ties in. Since there is then high pressure in this equalizer line, the heating expansion valve is kept tightly closed, and acts as a check valve to prevent a short circuit of refrigerant.

Now, trace through the heating cycle. Starting at the compressor discharge, vapor passes through solenoid valve No. 3 to the inside coil. There, it gives up its heat to the air, and is condensed into a liquid which then goes to the heating expansion valve. Note that there is high pressure vapor in the equalizer line to the cooling expansion valve, which keeps this expansion valve closed tightly and causes it to act as a check. Liquid passes through the heating expansion valve, where it is expanded down to suction pressure. From there it goes through solenoid valve No. 4 to the cooler. In the cooler, it absorbs heat from the water, is vaporized to a gas, and goes back to compressor suction. The water which has gone through the cooler is chilled and rejected to the drain.

Fig. 7 shows a basic diagram for a water-to-water heat pump with a fixed refrigerant circuit. This is more common in a water-to-water cycle than the fixed water circuit. In this system, the various components of the refrigeration cycle, the cooler and condenser, perform the same function at all times. The water lines are solid, the refrigerant lines dotted. For the cooling cycle, the 3-way valves are in the 1-3 position; for the heating cycle, in the 1-2.

The refrigerant cycle is the usual one. Compressor discharge through condenser to thermal expansion valve through cooler and back to compressor suction. The water paths, however, are changed from season to season.

Economy

A recently completed investigation comparing the air source heat pump with the conventional (i.e. electric refrigeration and gas heat) residential year-round air conditioners in a large number of important southern cities, shows that the heat pump is considerably higher in operating cost in all but two of these cities. These two cities had extremely low power rates for heat pump jobs. The first cost is particularly out of line, being almost 50% higher than conventional fuel-electric systems.

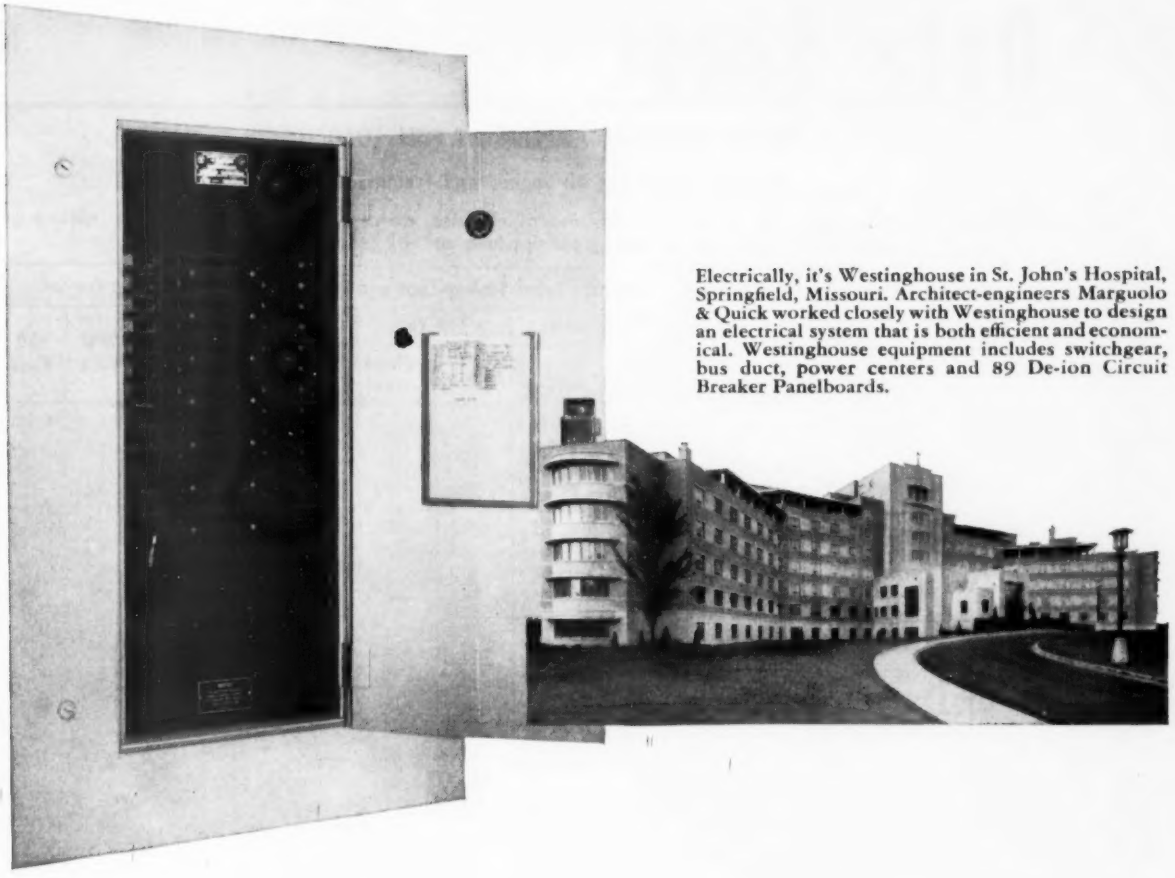
The water source heat pump has some important differences. In certain areas where heating requirements are light and where ground water is available in large quantities and at warm temperatures, the economics of the water source heat pump are sound. These areas are presently limited to Florida and the Gulf Coast states.

Electrical Work

At today's level of development of the heat pump, installations are generally of 3-hp and 5-hp standard packaged units, primarily in residential applications. The electrical work required for these installations is fairly standard and comparable to that for conventional self-contained air conditioning units of the same hp. Generally, three-phase 220- or 208-volt power is preferred; but where three-phase power is unavailable, single-phase 230-volt units can be applied.

Wiring the heat pump system involves the installations of power supply feeders and the necessary control wiring. For the most part, however, the electrical components of the heat pump unit are internal and factory-wired. Fig. 8 shows the basic wiring and control diagram for a typical reverse cycle self-contained unit. Although the installing contractor would normally not have to be concerned with this wiring, this diagram indicates the possible extent of maintenance and servicing.

This, then, is the fundamental story on the heat pump. A wealth of informative literature is available on this equipment.



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Data Sheet

MOTOR TERMINAL AMPERES AT FULL LOAD†

Average Values for All Speeds and Frequencies

TO DETERMINE SWITCH, FUSE OR WIRE SIZE for motor circuits, determine terminal ampere rating of motor either (a) from motor nameplate or (b) from this table.

HP.	Single-Phase a-c			Polyphase a-c (Induction Type) Squirrel-Cage and Wound Rotor								Direct Current		
				110 Volts		220 Volts§		440 Volts		550 Volts				
	115 Volts	230 Volts¶	440 Volts	3-Phase	2-Phase 4-Wire‡	3-Phase	2-Phase 4-Wire‡	3-Phase	2-Phase 4-Wire‡	3-Phase	2-Phrase 4-Wire‡	115 Volts	230 Volts	550 Volts
1/6*	3.2	1.6	...	...	...	...	...	...	...	...	...	...	...	...
1/4*	4.6	2.3	...	...	...	...	...	...	...	...	...	...	...	...
1/2*	7.2	3.7	...	4	4	2	2	1	1	.8	.8	4.6	2.3	...
3/4*	10.2	5.1	...	5.6	4.8	2.8	2.4	1.4	1.2	1.1	1	6.6	3.3	1.4
1*	13	6.5	...	7	6.4	3.5	3.2	1.8	1.6	1.4	1.3	8.6	4.3	1.8
1 1/2	18.4	9.2	...	10	8.8	5	4.4	2.5	2.2	2	1.8	12.6	6.3	2.6
2	24	12	...	13	11.2	6.5	5.6	3.3	2.8	2.6	2.2	16.4	8.2	3.4
3	34	17	...	...	...	9	8	4.5	4	4	3.2	24	12	5
5	56	28	...	...	...	15	13	7.5	7	6	6	40	20	8.3
7 1/2	80	40	21	...	...	22	19	11	9	9	8	58	29	12
10	100	50	26	...	...	27	24	14	12	11	10	76	38	16
15	...	...	...	...	...	40	34	20	17	16	14	112	56	23
20	...	...	...	...	...	52	45	26	23	21	18	148	74	31
25	...	...	...	...	...	64	55	32	28	26	22	184	92	38
30	...	...	...	...	...	78	67	39	34	31	27	220	110	46
40	...	...	...	...	...	104	88	52	44	41	35	292	146	61
50	...	...	...	...	...	125	108	63	50	50	43	360	180	75
60	...	...	...	...	...	150	129	75	65	60	52	430	215	90
75	...	...	...	...	...	185	158	93	79	74	63	536	268	111

*For running protection of motors of 1 horsepower or less, see Section 4322 N.E.C.

‡Current in common conductor of 2-phase, 3-wire system will be 1.41 times value given.

§For full-load currents of 208 and 200-volt motors, increase the corresponding 220-volt motor full load current by 6 and 10 percent respectively.

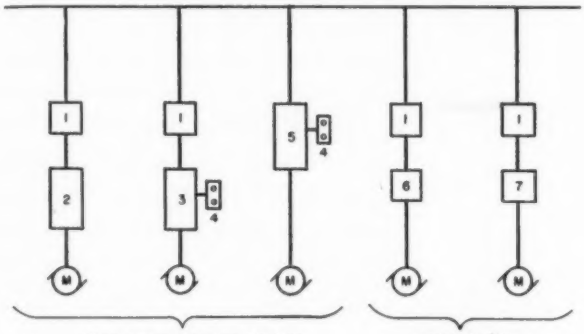
¶For full-load currents of 208 and 200-volt motors, increase the corresponding 230-volt motor full load current by 10 and 15 percent respectively.

†These values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

FUNCTIONS OF CONTROLS

1. Limit current to the motor during the acceleration period
2. Limit starting torque, proportional to the current multiplied by the field strength
3. Change the rotational direction of a motor
4. Limit the load, through the incorporation of overload relays
5. Disconnect the motor in the event of voltage failure
6. Govern rotating speed through armature control, changing the field strength or changing the supply voltage
7. Start and stop the motor at the travel limits of the load or at fixed points in the operational cycle
8. Stop the motor by either dynamic or friction braking, and
9. Protect the operator against shock, burns or mechanical injury.

OPTIONAL ARRANGEMENTS FOR CONNECTING POLYPHASE MOTORS



1—Fusible safety switch or circuit breaker
2—Manual starter
3—Magnetic starter
4—Pushbutton
5—Combination line starter with fusible disconnect or circuit breaker
6—Auto starter
7—Magnetic reduced voltage starter

Power may be supplied through cable-conduit, plug-in or trolley-duct, underfloor duct, wireways, etc.

Motor wiring may include remote controls, time switches, adjustable speed devices, etc.

THE THREE CUTLER-HAMMER STARS ★ ★ ★
STAND FOR THREE NEW STANDARDS

☆ *Installs easier*

The cost of installing motor control today is usually much more than the cost of the control equipment, often two to three times as much. Thus this new control offers *large* savings.

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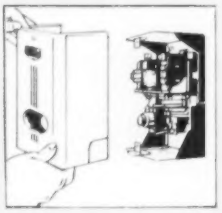
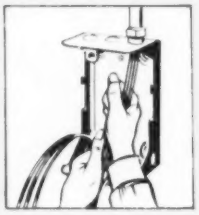
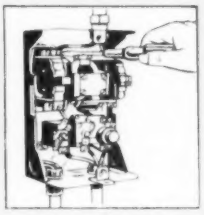
Just loosen two screws and off comes wrap-around cover. Screws stay in cover, do not fall on floor. Just loosen three screws and out comes the entire mechanism on unit plate.



Making conduit connections and pulling wires is a cinch; no starter mechanism in the way. No damaged starter parts or skinned knuckles. Wide-open accessibility, no side walls.



Easy straight-through wiring. All line terminals are at top, all load terminals at bottom. All terminals visible from front, all with solderless pressure connectors. Plenty of wiring room.



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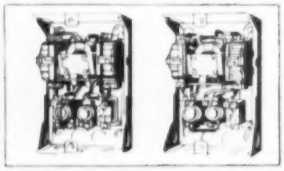
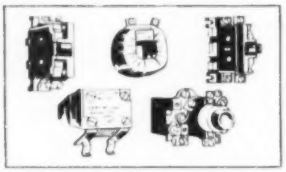
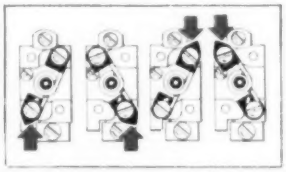
Better performance; dependably uniform operation, trouble-saving and cost-cutting more accurate overload protection. These are more than mere claims in this new Cutler-Hammer control. Field-tested over two years. Compared with every make of control by actual users...to have most say, "Better than anything we have ever used."



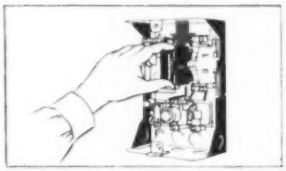
3-Coil Overload Protection. Another Cutler-Hammer "first," complete protection against single phasing as an optional feature in standard starter construction in standard enclosure.



5-Unit Construction. Just five units... magnet coil, armature, two contact blocks, and overload relay...and any unit can be removed from *front* without disturbing any other.



4-Position Overload Coils. Famous C-H Eutectic Relay now adjustable so motors can work harder *safely* without nuisance tripping. Each coil offers range of 4 ratings, selected by positioning.



Electrical Interlocks. Interlock blocks easily added to provide up to 4 extra control circuits; normally open, normally closed, or both.

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Many users will ask, "Why longer life? We have never had a Cutler-Hammer starter wear out." But there are two reasons for even longer life. First, it brings better performance to those "killer" jobs where industry expects Cutler-Hammer engineering leadership to prevail. Second, and *most* important, it decreases the *rate* of wear to the point where maintenance care and cost are virtually *eliminated* on most installations.

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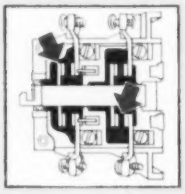
New pressure-quench arc chambers. Heat of any arc rapidly expands confined air; increased pressure snuffs arc. Contacts are *vertical* dust-safe design; twin-break contacts further minimize arcing.



Cutler-Hammer, Inc.—Milwaukee 1, Wisconsin

CUTLER-HAMMER ★★★ MOTOR CONTROL

Data Sheet

TABLE FOR SELECTING SWITCH, CIRCUIT BREAKER, WIRE AND FUSE SIZES FOR MOTOR BRANCH CIRCUITS

(Adapted from 1951 N.E. Code Chapter 10. Obtain proper terminal ampere rating of motor from horsepower table.

		To select proper size fuse, safety switch or circuit breaker for motor circuit Fusible switch or ABI breaker size for circuit protection columns 4, 6 and 8. Recommended rating of branch circuit breaker amperes based on 20 seconds accelerating time†									Wire Size (From 1951 Code Chapter 10)	
		Single phase, squirrel-cage and synchronous. Full-voltage, reactor and resistor starting			Squirrel-cage and synchronous auto-transformer starting. High-reactance squirrel-cage without code marking			a-c wound rotor and direct current			Minimum size conductor in raceways AWG and MCM	
1	2	3	4		5	6		7	8		9	10
Full load Current rating of motor	Non-fusible switch-size	Max. allowable rating of branch circuit fuses	Fusible switch	Circuit breaker	Max. allowable rating of branch circuit fuses	Fusible switch	Circuit breaker	Max. allowable rating of branch circuit fuses	Fusible switch	Circuit breaker	Types R, RW, RU, T, and TW	Type RH
Amp	Amp	Amp	Amp	Amp	Amp	Amp	Amp	Amp	Amp	Amp		
1	Non-fusible Safety Switches for Motor Circuits should be applied according to the 1951 National Electrical Code, Sections 4401 to 4411 inclusive.	15	30	15	15	30	15	15	30	15	14	14
2		15	30	15	15	30	15	15	30	15	14	14
3		15	30	15	15	30	15	15	30	15	14	14
4		15	30	15	15	30	15	15	30	15	14	14
5		15	30	15	15	30	15	15	30	15	14	14
6		20	30	15	15	30	15	15	30	15	14	14
7		25	30	15	20	30	15	15	30	15	14	14
8		25	30	20	20	30	20	15	30	15	14	14
9		30	30	20	25	30	20	15	30	15	14	14
10		30	30	25	25	30	20	15	30	20	14	14
11		35	60	25	30	30	25	20	30	20	14	14
12		40	60	25	30	30	25	20	30	20	14	14
13		40	60	35	35	60	35	20	30	25	12	12
14		45	60	35	35	60	35	25	30	25	12	12
15		45	60	35	40	60	35	25	30	25	12	12
16		50	60	35	40	60	35	25	30	25	12	12
17		60	60	50	45	60	35	30	30	35	10	10
18		60	60	50	45	60	35	30	30	35	10	10
19		60	60	50	50	60	35	30	30	35	10	10
20		60	60	50	50	60	35	30	30	35	10	10
22		70	100	50	60	60	50	35	60	35	10	10
24		80	100	50	60	60	50	40	60	50	10	10
26		80	100	50	70	100	50	40	60	50	8	10
28		90	100	50‡	70	100	50	45	60	50	8	10
30		90	100	50‡	70	100	50	45	60	50	8	8
32		100	100	70	70	100	50	50	60	50	8	8
34		110	200	70	70	100	70	60	60	70	6	8
36		110	200	70	80	100	70	60	60	70	6	8
38		125	200	70	80	100	70	60	60	70	6	6
40		125	200	70	80	100	70	60	60	70	6	6
42		125	200	70	90	100	70	70	100	70	6	6
44		125	200	70	90	100	70	70	100	70	6	6
46		150	200	70	100	100	70	70	100	70	4	6
48		150	200	90	100	100	90	80	100	90	4	6
50		150	200	90	100	100	90	80	100	90	4	6
52		175	200	90	110	200	90	80	100	90	4	6
54		175	200	90	110	200	90	90	100	90	4	4
56		175	200	90	120	200	90	90	100	90	4	4
58		175	200	90	120	200	90	90	100	90	3	4
60		200	200	90	120	200	90	90	100	90	3	4
62		200	200	100	125	200	100	100	100	100	3	4
64		200	200	100	150	200	100	100	100	100	3	4
66		200	200	100	150	200	100	100	100	100	2	4
68		225	400	125	150	200	125	110	200	125	2	4
70		225	400	125	150	200	125	110	200	125	2	3
72		225	400	125	150	200	125	110	200	125	2	3
74		225	400	125	150	200	125	125	200	125	2	3
76		250	400	125	175	200	125	125	200	125	2	3
78		250	400	125	175	200	125	125	200	125	1	3

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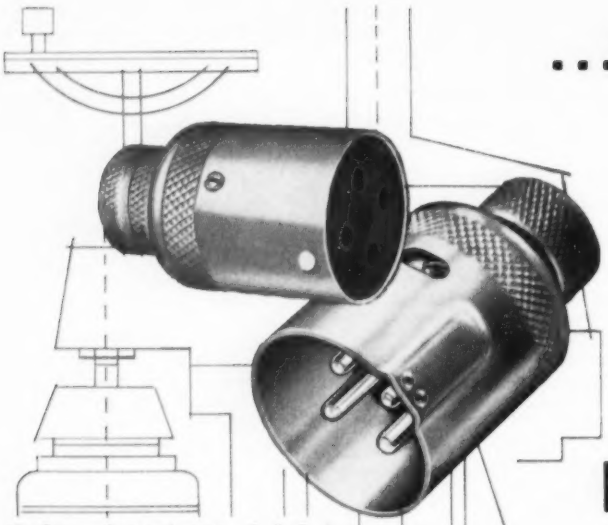
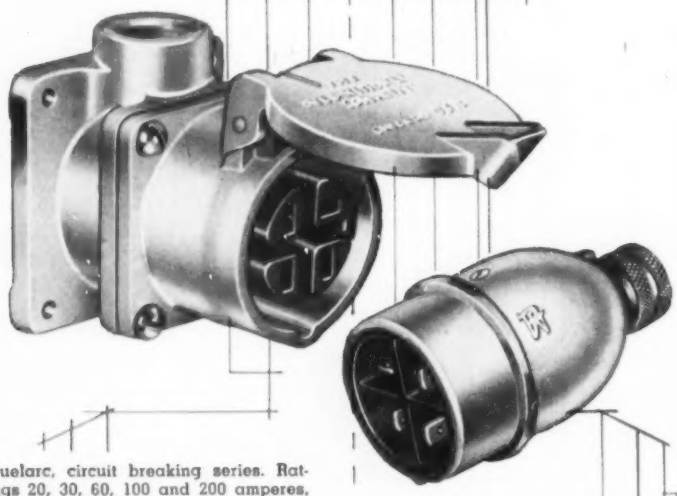


*Triploc, multi-circuit series. 1, 2, 3, 4, 6, 8, and 12 pole contact units interchangeable and reversible in any single set of housings. Housings of pressed steel with automatic lock or of cast metal threaded for watertight gasket seal. 2, 3 and 4 gang unit types for up to 48 poles also available.



*Quelarc, circuit breaking series. Ratings 20, 30, 60, 100 and 200 amperes, 250 volts d.c., 600 volts a.c. 2, 3, and 4 pole. Threaded cap, plain and hinged spring door housings.

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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
F. N. M. SQUIRES, *New York Board of Fire Underwriters, New York, N. Y.*

Wiring Suburban Homes

Q. *We have wired a great number of dwellings in our city and have used thinwall conduit concealed in the exterior wall of the dwelling from the weatherhead down to the service equipment and to our knowledge, there has never been a single instance where a lightning surge or an insulation failure has caused an electrical fault to occur within this concealed service conduit. Now we have just taken a contract to wire a number of suburban homes and the inspector in that area has asked us to keep these service conduits on the outside of the dwelling wall, and as we can find nothing in the Code to back up this request we are wondering whether or not he is justified in making it.*—D.B.

A. In areas subject to frequent lightning discharges, there is no question but what the placing of unfused conductors within the hollow spaces of a frame wall even though enclosed in conduit or electric metallic tubing presents a definite fire hazard. It is true at the present time that the National Electrical Code would not prohibit the running of this service raceway within this frame wall. However, Section 2331 does contain a fine print note which recommends that it not be done unless the conductors are protected with automatic overcurrent protection at their outer end.

As you may well appreciate, the National Electrical Code has been founded largely on experience had in our urban areas as the trend toward suburban and rural living is as yet comparatively new and if you will study lightning discharges, you will note their frequency within large built-up areas is much less than it is in rural or suburban areas due, we suppose, to the tendency of the conductive portions of the many buildings to dissipate the ground charges before they reach sufficient intensity to permit ionization of an air path. Since the advent of rural electrification, we have had considerable experience with lightning damage in dwellings and other buildings caused by lightning surges coming in over service conductors and because of this experience, I strongly recommend that you comply with the request of your inspector and keep the service raceways on the exterior surface of the dwelling walls or provide the overcurrent protective devices at the point of entry. There are now available low cost lightning surge arresters designed especially for this service and we recommend their use even though the raceways are kept on the exterior surface of the wall for all buildings in sparsely built-up areas either suburban or rural.—G.R.

Pulling Wires In Conduit

Q. *Section 3471 of the Code permits the use of four quarter bends, or the equivalent, in a run of conduit. Does this rule apply when lead conductors are used?*—E.T.H.

A. The above subject rule covers the maximum number of 90 degree bends, or the equivalent, permitted in a run of conduit and applies to conductors which are not lead covered. Table 5, Chapter 10 of the Code covers the number of lead-covered conductors permitted in conduit and the fine print note following the Table advises that "The above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter bends". As a result of this note, the maximum recognized under Section 3471 could not be used when lead-covered conductors are involved. The same distinction appears when making conduit bends. Under Section 3470, the table covering the radius of conduit bends, for various size conduits, shows that the minimum radius of a conduit enclosing lead-covered conductors is almost twice the size of that required for conduits enclosing other types of conductors. Field experience proves the need for such a distinction between the two types of conductors and if we do not see that these requirements are satisfied, we may expect to run into trouble when pulling wires in a conduit.—B.A.McD.

Derating Factors

Q. *Note 4 to Tables 1 and 2 of the Code shows a maximum of nine conductors in a single raceway or cable with a derating factor of 70% for the current carrying capacity of each of these nine conductors. In the event more than nine conductors were installed in a single conduit for a feeder or branch circuits and such circuits were specifically approved by the local inspection authority, what derating factor would have to be used?*—M.B.

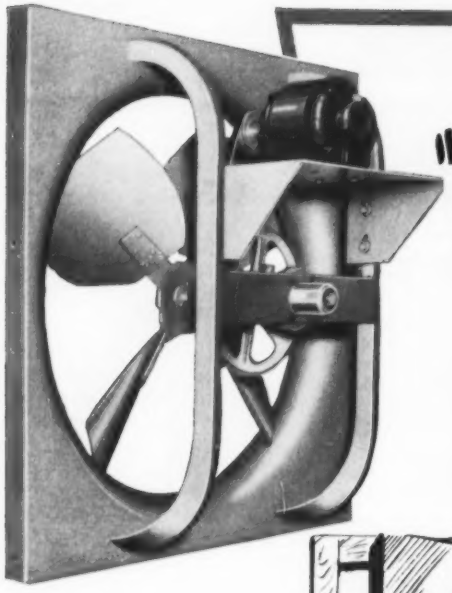
A. Current carrying conductors in a conduit may be thought of as heaters kept in a confined space. The heat is developed in the individual conductors by the watts loss in each conductor, i.e., the I^2R loss due to the current flowing in and the specific resistance of the conductor. Therefore, the more current that is passed through a conductor the greater is the heat produced, or for the same current in more conductors, the greater is the heat production.

The problem of heating of conductors is basically a heat flow problem. Some of this heat produced by the current carrying conductors will be lost to the atmosphere by conduction, convection and radiation. What remains in the conductors causes the temperature of the cables to increase. So basically we may state:

Heat stored in cable = Heat developed in the cable—Heat lost to the atmosphere.

Theoretically, for constant conditions, a state will be reached where the heat stored, or the final temperature of the conductor, will remain constant and can for any specific set of conditions of constant ambient temperature, fixed physical set up, etc., be said to be the maximum temperature for the cable. It can be seen that it is only necessary to coordinate all these facts to establish the cable maximum current carrying capacity which can be allowed to keep the temperature of the cable below the value established as detrimental to the cable insulation.

Mathematically these various heat values can be expressed quite accu-



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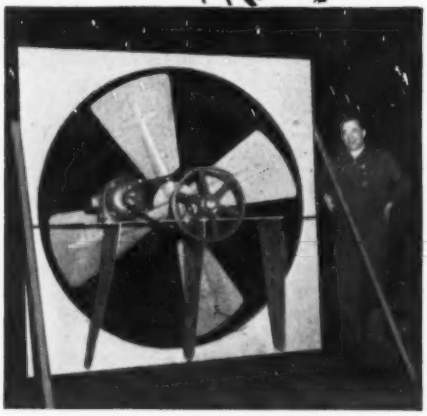

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rately. The following differential equation shows the basic mathematical expression:

$CdT = I^2R_n n(1 + aT)dt - KTdt.$,

Where C is the thermal capacity of the cable in watt seconds per unit length per degree centigrade per second,

dT is the temperature rise in the time interval dt (seconds)

I is the amperes per conductor

R_n is the resistance per conductor per unit length at the ambient temperature

n is the total number of conductors

a is the resistance temperature coefficient at the ambient temperature

K is the coefficient of the cable heat loss in watts per degree centigrade per unit length.

The integration of this equation for a solution leads to a rather complicated formula the presentation of which will not add a great deal to the discussion of this particular problem.

When the cable enclosed in a conduit are considered, additional factors enter into the heat flow problem. Now in addition to the resistance offered to the flow of heat from the cable by the cable insulation and the cable surface, two additional resistances are presented,

(1), the inner conduit surface and

(2), the outer conduit surface.

Several cable groups have worked to obtain mathematical formulas for the maximum allowable copper temperatures. Those developed by the "Insulated Power Cable Engineers Association" are generally accepted and used quite extensively. For cables in a single loaded conduit the current rating per conductor, I, is given by the following generalized formula:

$$I^2 \pm \frac{(T_c - T_a) - (T_d - T_a)}{n\,R_c\,(R_{th} + Q)}$$

Where T_c is the maximum allowable copper temperature °C.

T_a is the base ambient air temperature °C.

T_d is the copper temperature due to the dielectric loss alone

n is the number of conductors

R_c is the effective ac resistance per foot of conductor at the maximum copper temperature T_c

R_{th} is the thermal ohms resistance per foot of single isolated cable in air and is equal to the sum of

a. the thermal resistance of insulation per foot of cable, and

b. the surface thermal resistance per foot of cable.

Q is a factor to correct for the size of conduit and for one, two or three single or multiple conductor cables in the conduit.

(See IPCEA Bulletin "Current Carrying Capacity of Insulated Paper, Rub-

ber, and Varnished Cambric Cables" —1st Edition, Dec. 1943)

Even this formula must be modified to satisfy other conditions. Thus if several conduits are grouped in air and spaced closer than the diameter of a conduit, the mutual heating affects the value of Q and still another factor is introduced. Thus, for example, a group of conduits banked 5 wide and 5 deep (25 conduits in all) would require the Q factor to be multiplied by 2.79 to take care of the further restriction to heat flow.

At the present time there is not sufficient data available to accurately determine the value of $(R_{ta} + Q)$ for all sizes of conduits and for more than three single or multiple conductor cables in a conduit. However, it should be noted that in all these calculations the number of conductors is a major factor. It would seem that the current would vary inversely with the total number of conductors, so that for a particular size of cable, say 12 cables in a specific size of conduit, we would permit only half the current carrying capacity as we would permit for six of these same cables in a smaller conduit. Actually it is not a direct proportion since the above formula is a square value. Furthermore, six cables would generally be enclosed in a smaller conduit than would 12 cables of the same size. The thermal resistivity of the larger conduit would be less than that for the smaller conduit.

One suggested set of derating factors is shown by the following:

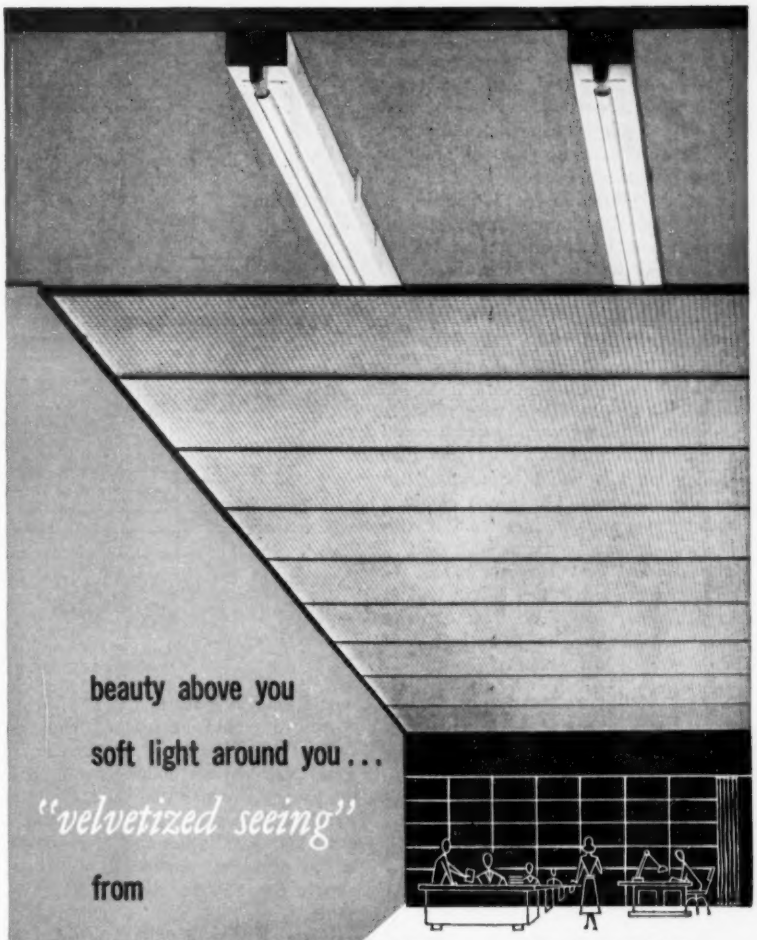
10 to 15 conductors	65%
16 to 24 conductors	60%
25 to 30 conductors	55%
31 and over	50%

It can be seen that actually from a practical point of view it may be better to split up the total wires into several conduits. First of all this will give a higher current rating to the conductors and secondly the overall cost may be less because of the smaller conduit runs which will have to be installed for the multiple conduit circuits. Only a complete cost analysis can give the complete answer to this problem.

A further suggested method of using these derating factors is shown by the following example. What would be the total allowable current carrying capacity of 40 No. 12 Type TW wires in a conduit? This is above 31 conductors so that the derating factor of 50% must be used. Since the rating of the No. 12 wire is 20 amperes, the total allowable current would be for all 40 conductors,

$$40 \times 20 \times .5 = 400 \text{ amperes}$$

This could be accomplished by loading each conductor to a maximum of 10 amperes or any combination of loads



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which would add up to a total of 400 amperes, as for example;

10 @ 20 amperes	200 amperes
10 @ 10 amperes	100 amperes
10 @ 7 amperes	70 amperes
10 @ 3 amperes	30 amperes

These 40 conductors would require a total area of

40 x .0384 sq. in or 1.536 sq. in.

At 40% fill the minimum size of conduit would have to be of an area of

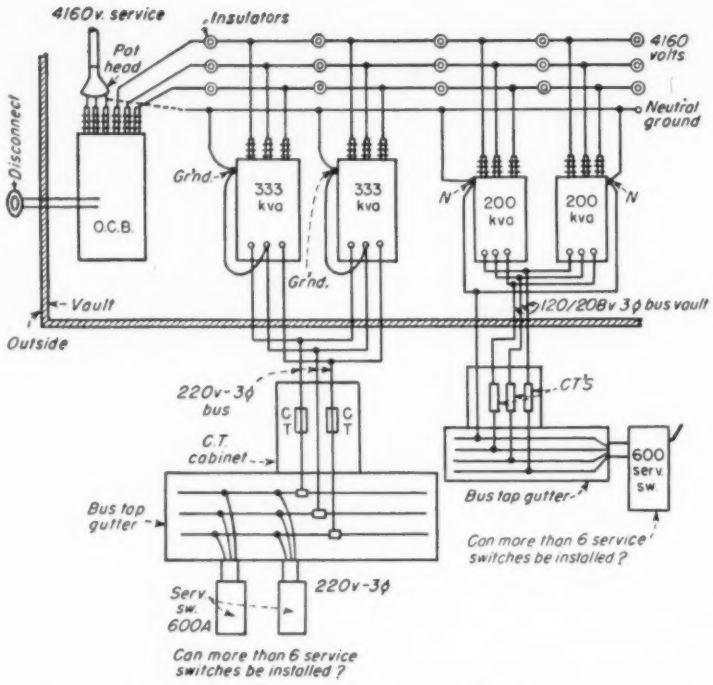
1.536/.4 or 3.84 sq. in.

A 2 inch conduit has 3.36 sq. in area and a 2½ inch conduit has 4.79 sq. in. area, therefore a 2½ in. conduit would be required. This conduit would cost, exclusive of labor, about 75 cents per foot. To obtain 100% wire capacity no more than three conductors could be run in a conduit or in this case ½ inch conduit could be used. But for the 40 wires, 12, ½ inch conduits with 3 wires and 1, ¾ inch conduit with 4 wires would be required. The ½ inch conduit costs approximately 12 cents per foot and the ¾ inch, about 15 cents per foot. So that actually these 13 conduit lines, exclusive of labor would cost about twice the 2½ inch line. The labor for the ½ inch line is of course less, but it is doubtful if the total labor for all these smaller lines would be less than that required for the one 2½ inch line.

So all in all, it can be seen that while derating factors may be necessary for more than nine conductors in a raceway, much study remains to be done before an equitable, practical code solution can be offered.—B.Z.S.

High Voltage Services

Q. *Can the O.C.B. owned by the Utility be used as a single service disconnect if the Utility owns the O.C.B. and transformers as shown below? Must two O.C.B.'s be used, one on each bank of transformers? Must the secondary circuits not contain more than six service switches each or not more than six as a whole? The vault belongs to the customer, located inside the building being served.*—P.P.G.



A. Services exceeding 600 volts are covered by Section 2386 to 2392 of the N. E. Code. According to the fine print preceding these Sections, when the equipment within a vault is under the sole control of the Utility, none of these rules apply and there are no requirements for primary circuit breakers or other control or protective equipment under such conditions. Since the Breaker and the Transformers are owned by the Utility, it usually follows that the maintenance and inspection of this equipment would be restricted to the Utility and therefore would be under their sole control. Such control is assured, in some cases, by an understanding with the property owner that they, the Utility, assume responsibility for the equipment and installation and there should be no occasion, outside of an emergency, for anyone else to enter the vault.

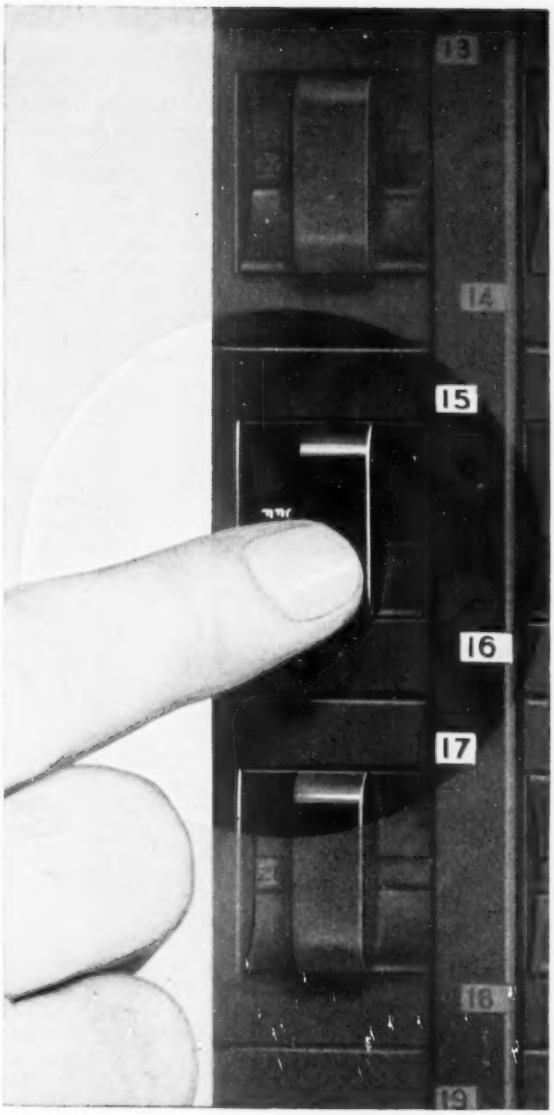
If the Utility installs a breaker as shown in your illustration, and is subject to Utility control, it could not, in my opinion, be recognized as the disconnect and overcurrent protection required by Sections 2388 and 2389. This opinion is based on past experience which indicates that the Utility will not assume responsibility for complying with Code rules when they are not required to do so. Under the circumstances outlined, they could, at their discretion, remove the breaker at any time.

If the installation was not under the sole control of the Utility, the primary means of disconnect and overcurrent protection must comply with Sections 2386 and 2389 as outlined when the equipment is installed in a standard transformer vault. Section 7132 of the Code requires each transformer or bank of transformers operating as a unit, to be separately controlled and protected as specified in Section 4512. It appears to me from your illustration that the two 333 kva transformers are connected in multiple and not as a bank of transformers. This condition is also common to the 200 kva transformers. As a result, we have four operating units and each unit must be separately protected by overcurrent devices as required by either of the two methods presented by Section 4512 A or B. There is an exception however when the main overcurrent device is set at not more than 250 percent of the rated primary current of the smallest transformer, or when the exception covered by Section 4512-b, which involves secondary protection and coordinated thermal protection is satisfied. It appears to me that the first exception would be difficult to satisfy in the case you have presented.

In answer to your last question, I believe in line with the requirements of Section 2301, we do have two separate secondary services which are required for different classes of use. As a result, we could have six means of secondary service disconnects for each of the two services.

Section 2392 of the Code recognizes the use of a primary circuit breaker which is manually operable from a point outside the vault as serving the purpose of a secondary disconnect and overcurrent protective, provided only a single set of mains are involved and the setting of the primary breaker is such as to protect the secondary circuit. These requirements are not in my opinion satisfied in the case you have presented.

I also note that the secondary wiring circuit covering, the three phase, four wire system, as shown in the illustration is not correct. The neutral of this system would come direct from the secondary Wye connected transformers and not as shown in the illustration.—B.A.McD.



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Electric Ranges

Q. *A local contractor has just attempted to return to us several ranges which he recently purchased and installed in homes he was building for sale, claiming that he could not use them as the local inspector would not approve them. We find that this range is listed by the Underwriters' Laboratories, Incorporated and that the local inspector refused to accept the installation because the contractor had built them into the kitchen cabinets. We have seen a number of other installations where ranges have been so installed and are unable to understand the inspector's action. Is he justified in this case?*—H. M.

A. Section 4234 of the Code states that each electrically-heated appliance which is obviously intended by size, weight and service to be located in a fixed position shall be so placed as to provide ample protection between the appliance and adjacent combustible material. Electric ranges submitted to the Underwriters' Laboratories for test and listing are divided into three classifications by the Underwriters' Laboratories, depending entirely upon their construction. These classifications are defined as installation form. Form No. 0 is for those ranges which may be placed with their back against a vertical wall and the two ends against built-in cabinets or vertical walls; No. 1 installation form requires at least one-inch air separation at each end of the range; installation form No. 6 requires six inches of air space at both ends and at the back of the range.

Apparently the range you have sold is either of installation form No. 1 or No. 6 construction if the inspector has prohibited its use when built into the cabinets in the kitchen. As you did not provide me with either the manufacturer's name or the model number, I am, of course, unable to determine just what classification the Underwriters' Laboratories have placed the range in question within, but that will be indicated on the label attached to the range.—G.R.

Over Three Conductor Penalty

Q. *According to table 1, note 4, the current capacity of a conductor shall be reduced to 80% (70%) of the values in table 1 if 4-6 (7-9) conductors are run in a raceway. Does this mean that 15 amp breakers (instead of 20 amp breakers) must be used if 6-8 No. 12 TW branch wires*

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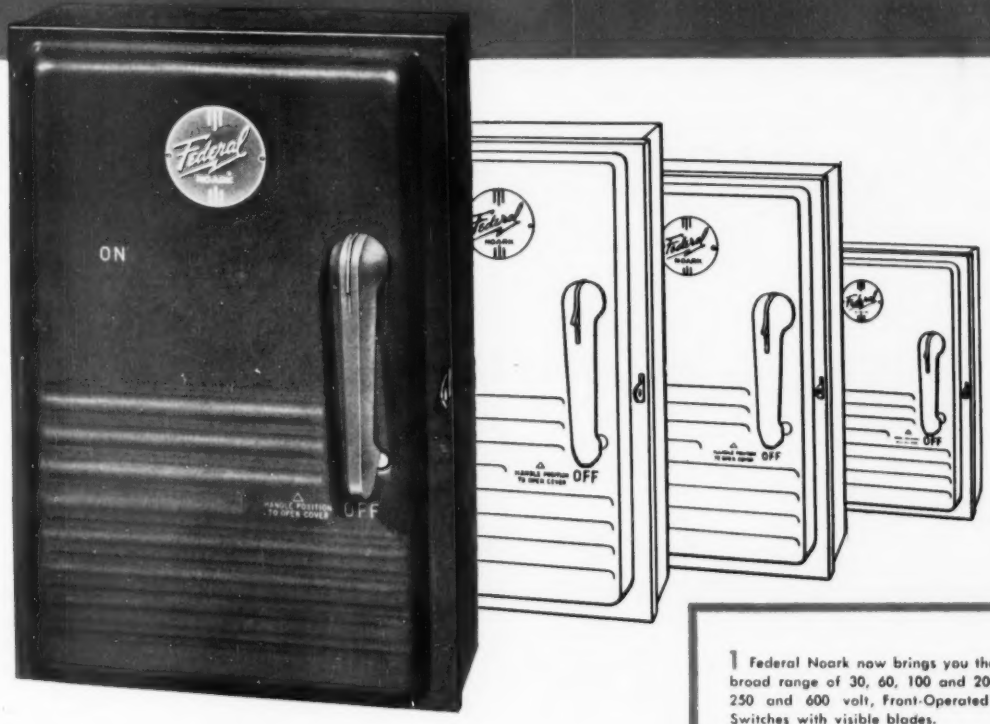

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In addition, these Noark Front-Operated Safety Switches have accommodations for four padlocks . . . and the five special features (described at right) assure coolest, safest operation and longest service life.

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2 Pressure spring of the patented fuse holder is located in block under fuse where unaffected by fuse heat. High-pressure lever action provides good contact with minimum contact resistance, assuring cool operation.

3 Only Federal Noark Front-Operated switches have the operating cross bar *beneath* the visible switch blades, forcing all blades open, safeguarding the operator.

4 In this new switch there are only two joints at each pole and both are under extreme pressure. This is the coolest, most practical switch blade construction ever designed.

5 100 and 200 amp. 250-volt devices have arc mufflers . . . all devices over 250 volts have patented Rolarc® Arc Snuffers. Both extinguish arcs instantly and prolong blade life.

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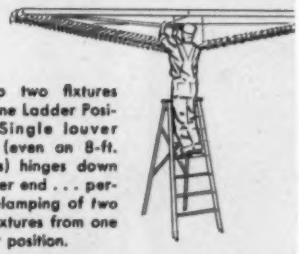
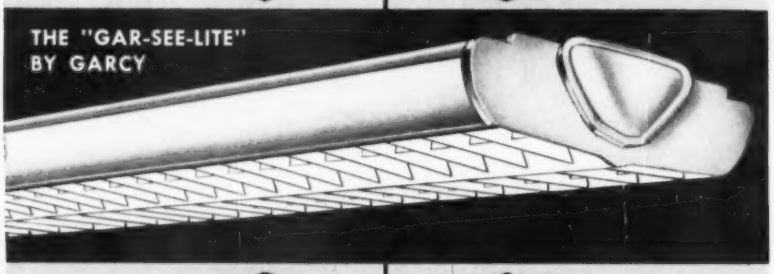
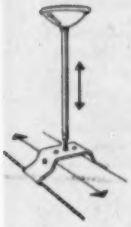


Relamp two fixtures from one Ladder Position. Single louver shield (even on 8-ft. fixtures) hinges down at either end . . . permits relamping of two 8-ft. fixtures from one ladder position.





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are run in a 1-inch conduit (or 3-3 phase circuits in a 1¼-in.)? I have often seen two. 4 wire circuits (total 6 wires according to table 1, note 5) protected by 20 amp breakers, run in 1-inch conduit.—S.E.S.

A. It is my opinion that the 70% and 80% penalties imposed on account of the number of conductors in a raceway or cable is intended to apply to the current-carrying capacity of the conductor and not the overcurrent protection of the conductor. In the case you mention, the carrying capacity of the No. 12, TW conductors, when six are run in one raceway would be 80% of 20 or 16 amps. If eight were run in the same raceway the carrying capacity would be 70% of 20 or 14 amps. If the rule applied to overcurrent protection a 20 amp branch circuit would become a 15 amp circuit in the first case and a 10 amp circuit in the second. This, I believe, was not intended. Official Int. No. 355 appears to verify this opinion. It reads:

Question 1. Table 1. Is it the intention of the Code that Table 1 permits six 115 volt branch lighting circuits derived from a 3-phase 4-wire supply and comprising a total of eight No. 12 conductors to be run in a single conduit?

Answer: Yes

Question 2. Section 2403: In view of the reduced allowable current specified in Table (Note 4) for the conductors installed in this single conduit, may single pole nonadjustable circuit breakers, rated 20 amperes, be chosen as the overcurrent protection specified in paragraph b, Section 2403 of the Code?

Answer: Yes—B.A.M.D.

Motors for Elevators

Q. *We are installing two 7½ horsepower motors in a cupola of a new elevator to drive two separate legs. May we use a single disconnecting switch located in a dust free section of this elevator building as the disconnecting means for both of these motors? They will have individual stop and start buttons on both the work floor and the cupola floor with those in the cupola being of the lockout type. The individual magnetic controllers will, of course, be located in the dust free area of the elevator.*—B.B.H.

A. Section 4410 of the Code states that each motor shall be provided with individual disconnecting means, except that for motors of 600 volts or less a single disconnecting

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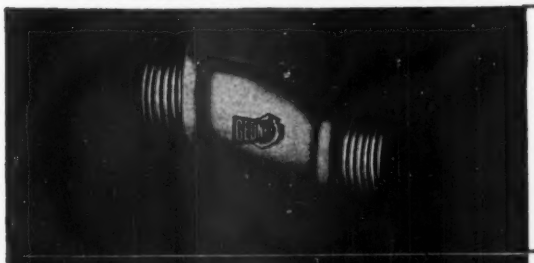

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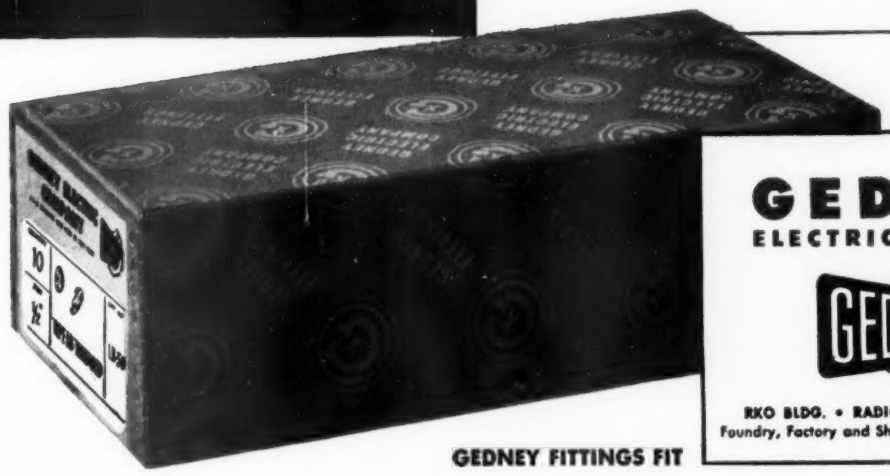

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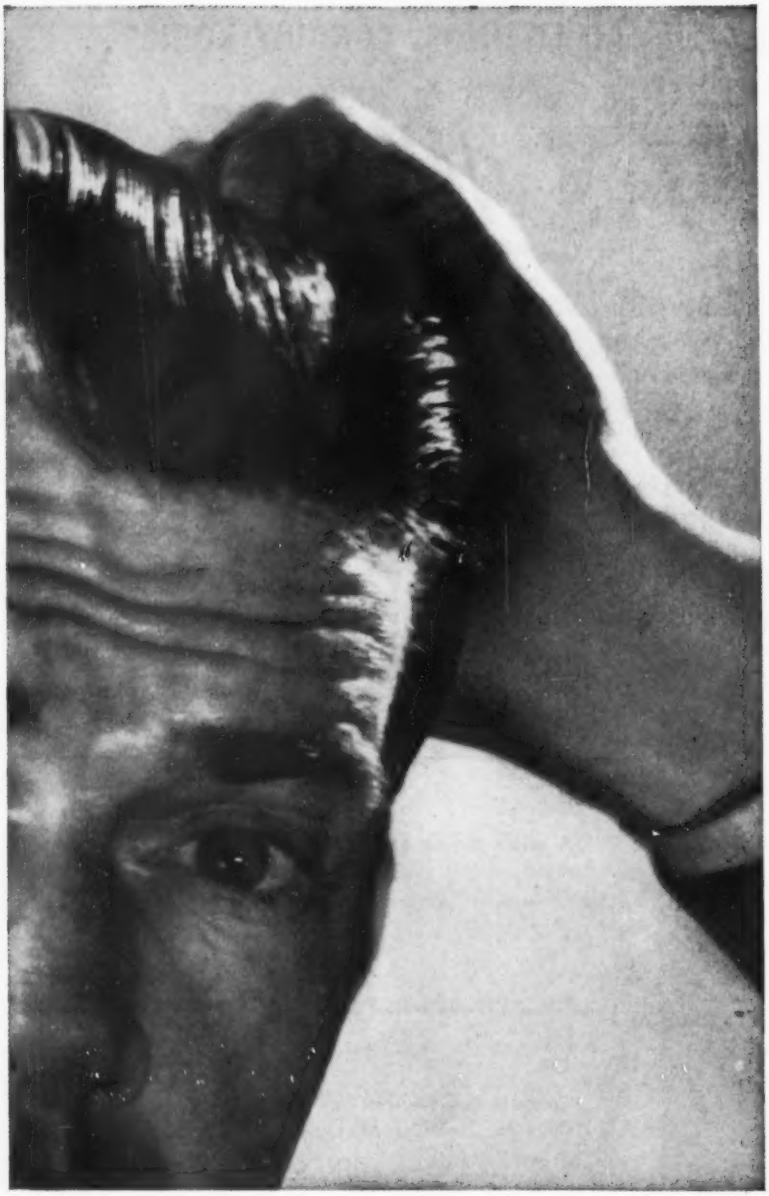

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means may serve a group of motors under one of the following conditions:

1. Where a single machine has multiple motor drive.

2. Where a group of motors is under protection of one set of overcurrent devices as permitted by paragraph a. of Section 4343.

3. Where a group of motors is in a single room within sight of the location of the disconnecting means.

Obviously the situation you have in mind could only be covered by the second exception quoted and under paragraph a. of Section 4343 you will note that the limitation is for motors not exceeding one horsepower or having a full load current rating not exceeding six amperes. Therefore, the Code would not give you permission to use the single disconnecting means for this installation.—G.R.

T Insulation In Raceways

Q. *Why is Type T and TW wire approved for insertion into raceways? I remember the old type SN which was not satisfactory and the new type T and TW are equally not satisfactory for pulling in raceways. Even with extreme care, Types T and TW are easily damaged. Type R and RH wires are much more trouble free. Please comment.*—P.P.G.

A. According to Section 3102 of the Code, both Types T and TW conductors are approved for use in conduit or tubing. Section 3013 covers Code requirements for the insertion of such conductors in raceways and recognizes the use of lubricants if necessary. The area of such conductors is considerably smaller than the areas of the same size Type R and RH conductors. It appears to me, in the absence of unfavorable field experience, that the Code recognizes and will continue to recognize the use of such conductor insulations when inserted in raceways.

Several years ago, Type T conductors were criticized as being difficult to pull in conduits and that they were stiffer than Type R conductors. As a result, Underwriters' Laboratories ran a conduit-pull test on large sizes and published a fact-finding report on the results, which showed no difference between Types R and T on such a test. At that time, 1946, a manufacturer's representative commented as follows: "This surface (Type T), while it is extremely smooth to the feel, has a high degree of cohesion and if you do not provide a properly lubricated surface at the time the wire is manufac-

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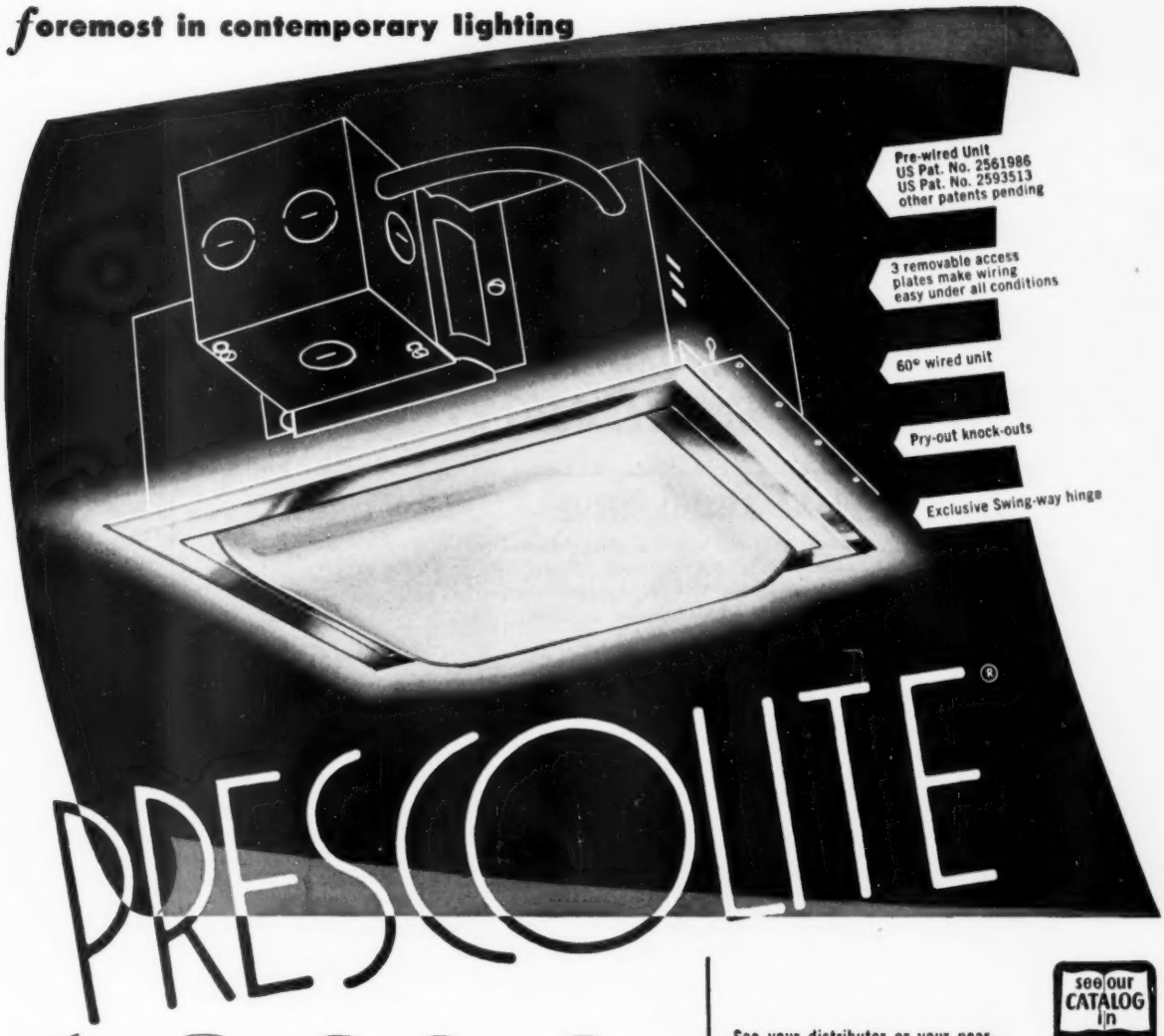

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tured, it is true that there will be trouble pulling the wire". Evidently this objection has been satisfied since 1946, in view of the absence of continued field criticism and the additional fact that in 1951 the Code eliminated the restriction that limited Type T conductors in raceways to four naught.

Irrespective of the foregoing, your comments from the field warrant consideration especially if the conditions of use fully satisfied all Code requirements for raceways and conductors and the conductors complied with the standard of U. L. If you feel that all conditions are satisfied and you find that such insulated conductors are still difficult to pull in conduits, your advice would be appreciated, provided all details concerning the run such as bends, length, conduit size, conductors used, lubricant, workmanship and any unusual condition of temperature or the run in general is reported.—B.A.McD.

Wiring of Freezing Rooms

Q. *A poultry produce plant here is installing a new series of freezing rooms and they are wondering just what is necessary to avoid condensation troubles in the electrical wiring which will be installed in these rooms. The wiring contractor intended to use ordinary rigid conduit and Type THW wire with a seal off in a junction box just outside each freezer room wall. I believe the temperature in each room will be approximately zero except for one room where the poultry will be quick frozen and that room I understand will be kept at about 40 below zero. Must a sealing fitting be used in each conduit entering or leaving these rooms, or may some other method be employed to avoid condensation troubles?*—L.H.

A. Under Section 3015 you will note that the Code simply requires some means be made to prevent circulation of air from a warmer to a colder section through any raceway system extending into a cold room. Therefore you might accept any means which in your opinion will prevent air circulation from a heated area into these cold rooms. I would suggest, however, that you caution the contractor about making sure that whatever means he employs be most carefully done to make sure no air can pass through the conduit entering these cold rooms.

We would also suggest he use something other than ordinary rigid conduit inasmuch as experience in other

Why you should use G&W POTHEADS on rubber insulated, shielded, Neoprene jacketed 15 Kv. cables

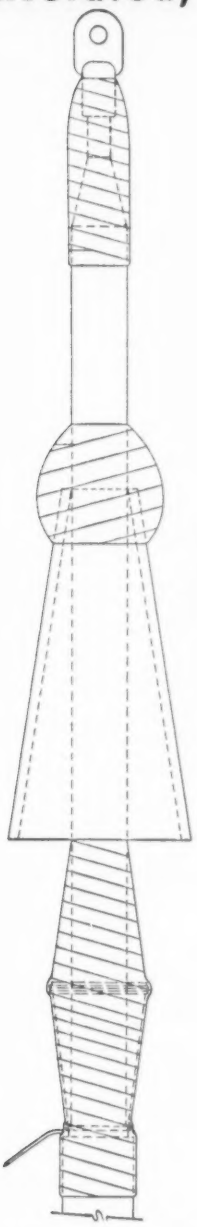


Fig. 1—Cable termination. Exposed insulation subject to deterioration by weather.

Fig. 2—Pothead No. T17231. Permanent protection for cable ends.

Increasing the creepage length on a cable in air beyond a certain distance increases the flashover very little—because ionization of the air (corona) begins at the grounded shielding terminus at the same potential (for a given cable) regardless of the length.

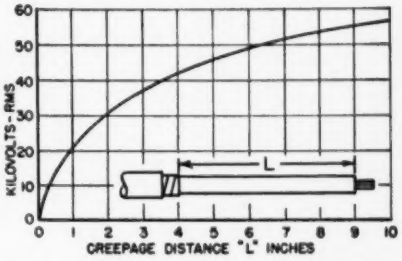
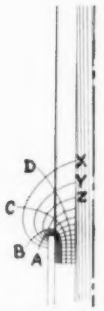


Fig. 3—60 cycle dry flashover values of various lengths of 2/0, 15 Kv., 22/64" rubber insulated cables IN AIR.



Equipotential lines—
A—B—C—D

Flux lines—
X—Y—Z

Fig. 4—Without stress relief cone. High electrical stresses at grounded shielding may cause insulation failure.

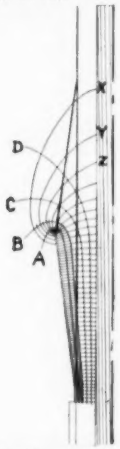


Fig. 5—Stress relief cone decreases radial electrical stresses in the cable' insulation but has little influence on longitudinal stresses.

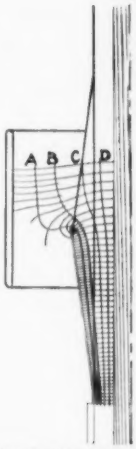


Fig. 6—Further decrease in concentration of flux lines and increase in electrical strength is provided by proper location of grounded pothead body.

A. Exposed insulation surfaces become coated with contaminating dust and in coastal zones salt condensation – which become conducting when wet. As the conducting surface dries unevenly, excessive voltage gradients develop over small areas – arcing can occur and carbonize the organic insulation of a cable termination and result in dielectric breakdown. Inorganic porcelain as used in a pothead is not so affected.

B. The principal benefit of the stress relief cone is in the improved strength of the installation due to an increased resistance to puncture of cable insulation at the grounded shielding terminus where the stress is greatest.

C. Cable surface flashover is increased by the use of insulating compound which has a high dielectric strength compared to air. A pothead provides a container for compound and the compound permits a considerable reduction in the length of the installation.

D. The pothead porcelain provides an outer surface of relatively large diameter compared with the cable, thus reducing the external voltage stresses.

E. High external creepage distance for a given length of porcelain is provided by petticoats which improve the wet flashover characteristics.

F. Potheads (porcelain insulated, compound filled, hermetically sealed) properly protect cable ends against the contaminating effects of weather. G&W potheads meet established A. I. E. E. standards of 60 cycle and impulse voltage withstand values. The extra cost of a pothead (fig. 2) over the cost of materials required for a cable termination (fig. 1) is relatively small – compared with direct and intangible losses resulting from service interruptions due to failures of improperly protected cable ends.

Bulletin AB51 lists potheads with stuffing box seal for Neoprene jacketed cables.

Bulletin A52 gives data on stress relief cones for potheads.

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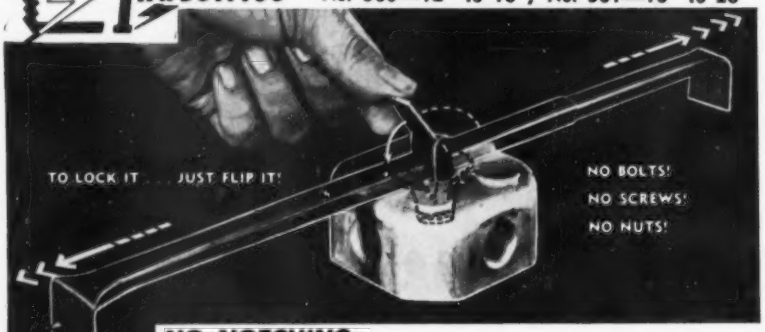

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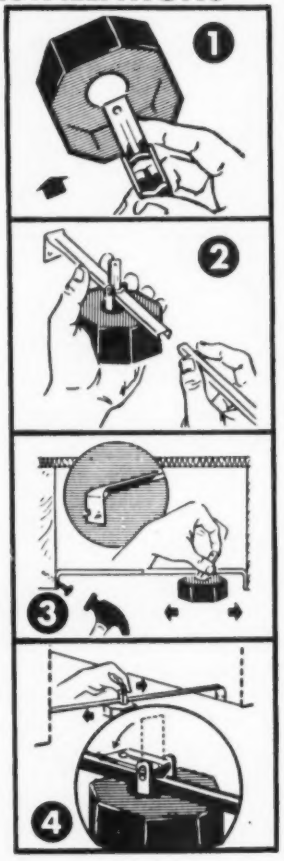

1. Insert stud from inside of outlet box thru center hole. NOTE: Threaded part and both lips of stud will then be on inside of outlet box.

2. Insert female bracket between stud uprights on outside of outlet box. Slide male bracket into female bracket.

3. Place assembled unit between joists so right angles of bracket are flush with joist ends. (See inset.) Notched points will hold assembly in place for nailing. Drive nails at 45° angle.

4. Slide box into desired position. Press flipper down until secure on bracket arm. NO OTHER bar hanger gives you this quick, no-notch permanent installation!

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meat packing plants has indicated that life expectancy especially in the storage rooms maintained at approximately zero will be relatively short and as a result a number of installations have been made using waterproof types of wiring conductors supported on insulators in these areas. Then by placing the proper load on each circuit they can operate these circuits at sufficient temperature to make impossible the formation of frost on the individual conductors. Care of course must be exercised so the conductors will not be operated at too high a temperature as that might injure the insulation itself.—G.R.

Conduit Fills

Q. *I would appreciate receiving your answer and comments to the following questions on the National Electrical Code:*

a) Which sections of the Code cover and define rewiring rules as they pertain to conduit fills?

b) Where is specific mention made that the cross-sectional area of Type T, TW, etc., as given in Table 13, may be used in computing percent fills as given in Table 11 for rewiring existing raceways?

c) When due to increased loads, may larger size conductors of the T, TW, etc., type be installed in an existing raceway, which is exposed and accessible, based on the areas and percent fills for rewiring as given in Tables 13 and 11?

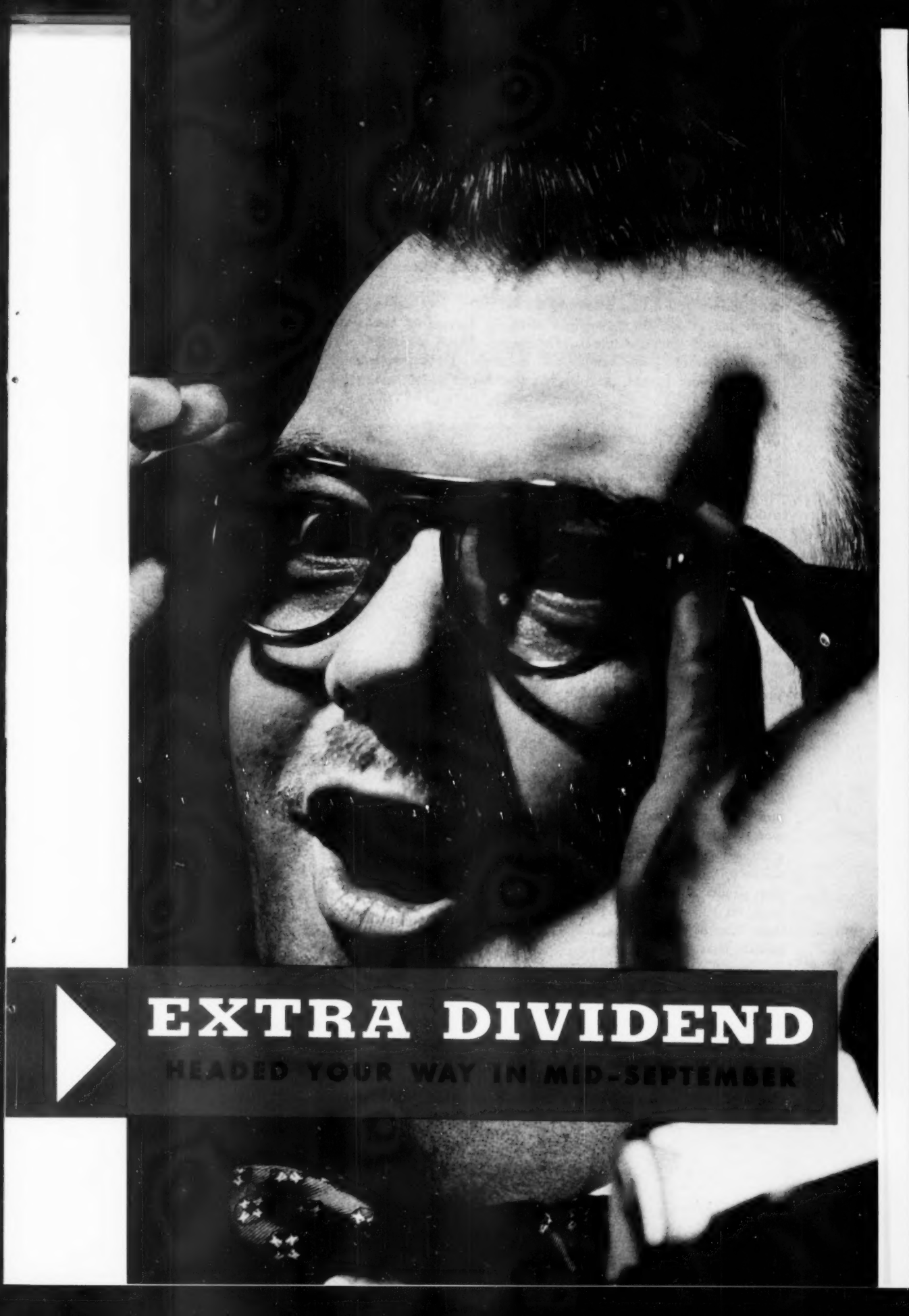
d) What is your interpretation of the phrase "where it is impracticable to increase the size of the raceway due to structural conditions"?—S.L.S.

A. Question A: Section 3466 specifies that one conduit shall not contain more conductors of a given size than are specified in Tables 4 to 11 of Chapter 10. Reference to Table No. 11 covers this question. It reads as follows: "For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions".

Question B: A fine print note following Table No. 11 reads as follows: "See Tables 12 to 19 for dimensions of conductors, conduit and tubing". Since Table No. 11 covers the percent conduit fill allowed when rewiring existing raceways, the fine print note which follows same is our authority to use the c.s. areas of Type T, TW, RU etc., as covered in Table No. 13. Official Interpretation No. 316 verifies this opinion.

Question C: While the Code recog-

[Continued on page 210]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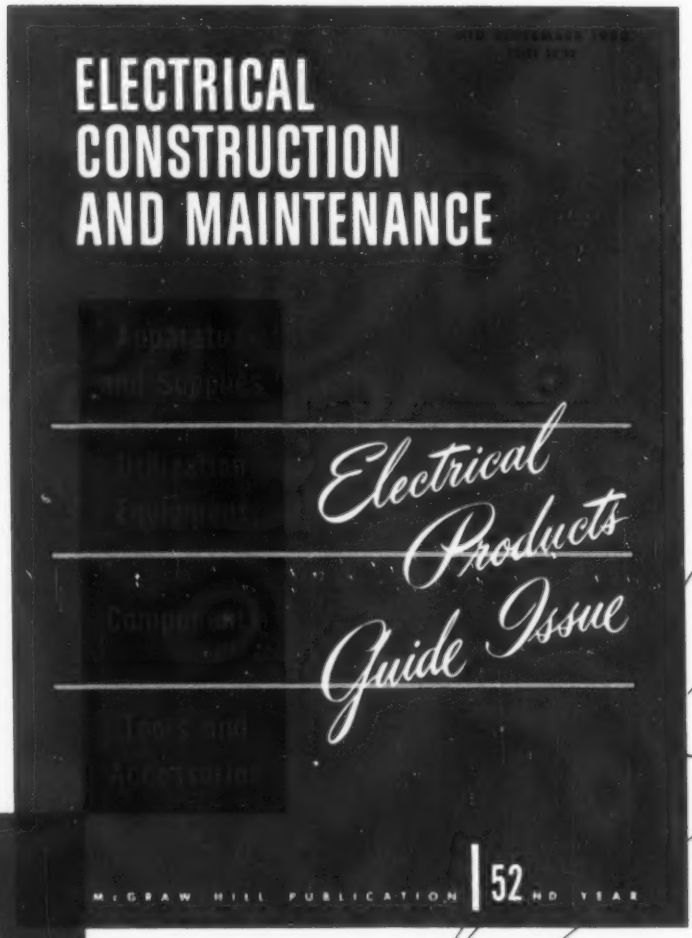

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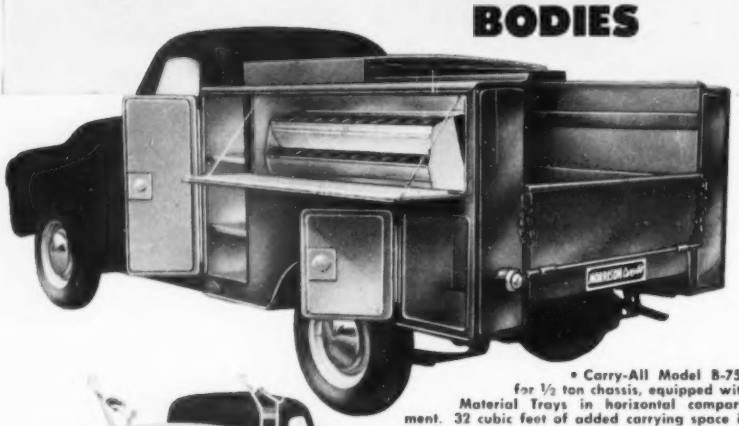

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nizes the need for rewiring is due principally to increased loads, it does not permit the use of existing raceways with increased percent fills unless it is impracticable to increase the size of raceway due to structural conditions.

Question D: I believe Official Interpretation No. 286 tends to clarify the rule and also answers your question. It reads as follows:

"Question: Is it the intent of Table No. 11–1947 edition of the National Electrical Code to permit rewiring in exposed raceways, where it might be necessary to enlarge holes through floors, walls etc. and thereby disfigure the finish of buildings to install larger size raceways?

"Finding: No, it is the intent that this provision apply to concealed raceways."

This interpretation, in my opinion, clarifies the intent of the words "where it is impracticable to increase the size of the raceway due to structural conditions". It tells us that the raceway must be concealed. To me, this means that the raceway could be buried in the ground, it could be embedded in concrete in a building wall or floor or it might be concealed behind a false ceiling if the space involved would not permit replacement without removing the ceiling. The questions which you have raised have previously come to the attention of the Electrical Committee and a new proposed wording of Section 3466 is now under consideration which, if accepted, will clarify the intent of the rule.—B.A.McD.

Pull And Junction Boxes

Q. *Please explain the Code rules of Section 3708.*—C.Y.

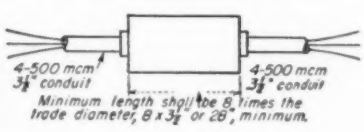
A. First off, it must be understood that the requirements of paragraph "a" apply, only when two conditions exist:

(1) raceways entering pull and junction boxes are 1¼ inch trade size or larger, and

(2) No. 6 conductors or larger are installed in these raceways.

Thus a 1 inch conduit with 3 No. 6 would not come within the scope of these requirements, neither would 1¼ inch conduit with six No. 8 conductors.

For straight pulls, the calculation is quite simple. For example, the following diagram illustrates the use of the straight pull box for a single line.



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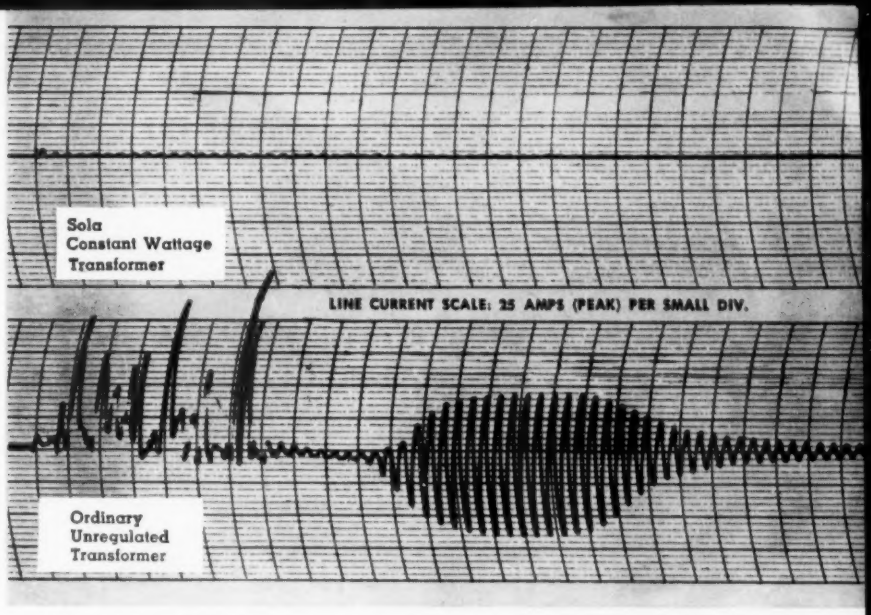

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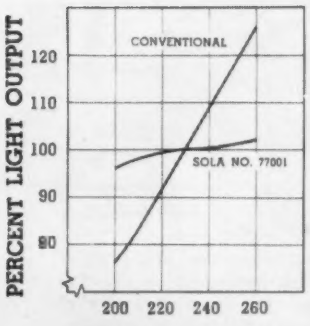

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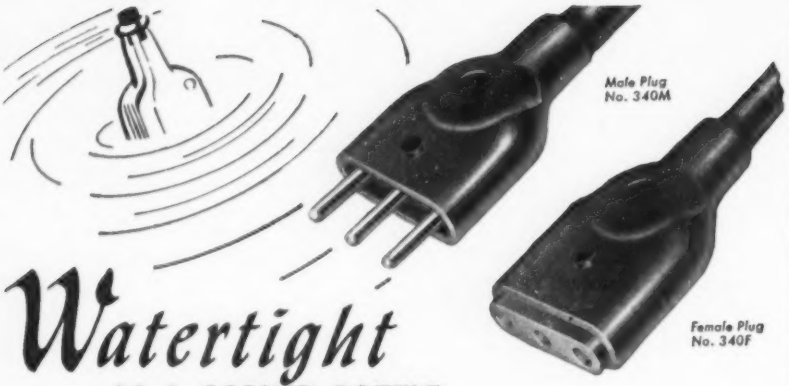

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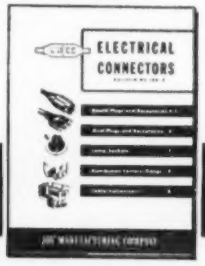

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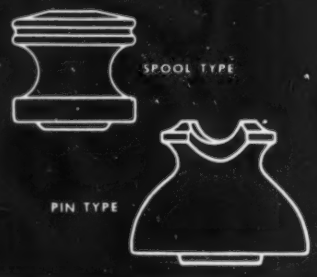

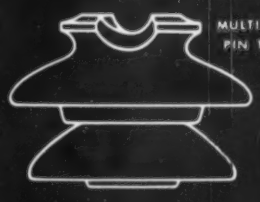
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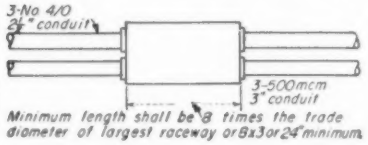
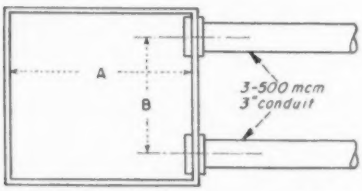
Suppose two conduits enter and leave the pull box as shown by the following:


3-No 4/0
2½" conduit
3-500mcm
3" conduit
Minimum length shall be 8 times the trade diameter of largest raceway or 8x3 or 24" minimum.

The width is governed by the locknut dimensions. The maximum dimension for the 2½ in. and 3 in. locknuts, are, approximately, 3½ in. and 4¼ in., respectively. Figuring about ⅛ in. clearance between locknut corners we would have a minimum width of 3½ in. plus 4¼ in. plus ⅛ in. or 7⅞ in. The depth of the box would be determined by the larger locknut, in this case 4¼ in. So that for all practical purposes the minimum size box would be 8 in. wide by 5 in. deep by 24 in.

Next let us consider the pull box for a "U" pull. Here the same size conduit and wire feeds from the same wall of the pull box.



Dimension "A" (note this shall be the inside box dimension) shall be at least 6 times the trade diameter of the conduit so that this will require 6 times 3 or 18 in. minimum. A second requirement states that the distance between raceway entries enclosing the same conductors shall be not less than 6 times the trade diameter of the larger raceway. Therefore dimension "B" will have to be at least 6 times 3 or 18 in. minimum.

The minimum width will also have to take into account the overall maximum width of one locknut (½ locknut for each conduit), so that to this latter 18 in. must be added 4¼ in. for a locknut. The minimum depth is only governed by the overall locknut dimen-

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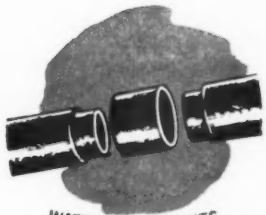

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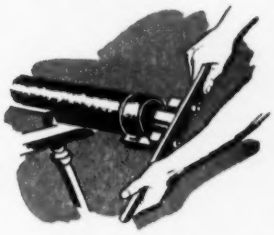

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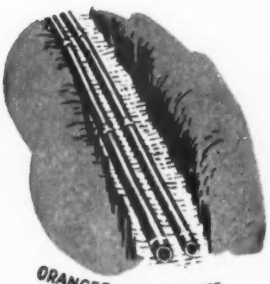

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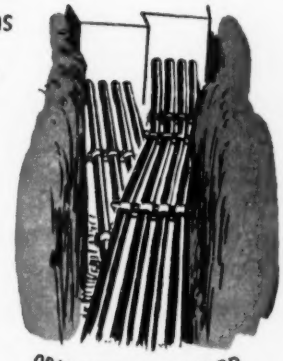

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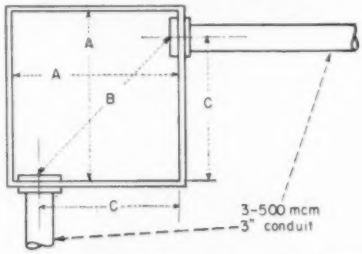
sion, so again for a practical solution would show the following minimum inside dimensions for the box: 23 in. wide by 5 in. deep by 18 in. long.

For angle pulls for a single entry as for the "U" pull box discussed above, the calculations are somewhat similar. Using the following sketch we can show steps for determining minimum inside dimensions.



Both "A" dimensions shall be at least 6 times 3 in. or 18 in. minimum.

Dimension "B" shall be 6 times 3 in. or 18 in. minimum.

For a minimum box size both "C" dimensions should be equal. Using the basic right triangle mathematics we know that

$$B = \sqrt{C^2 + C^2} = C\sqrt{2}$$

$$\text{or } C = B/\sqrt{2} = B/1.42$$

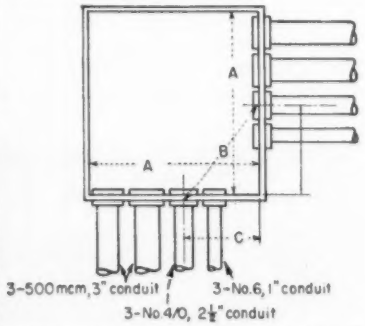
Therefore C shall be

$18/1.42 = 12.67$ in., minimum

Add to this one half locknut dimension or $2\frac{1}{8}$ in. we have a minimum dimension of

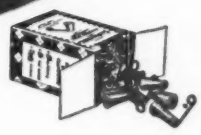
12-2/3 in. plus $2\frac{1}{8}$ in. or 14-19/24 in. The minimum dimensions as set up by the first rule give us 18 in. so that this will also satisfy the requirements of the second rule provided we keep dimension "C" at least 13 in. (for practical measurement purposes). The locknut dimension will govern the depth so that the minimum inside dimensions of this box would be 18 in. wide by 5 in. deep by 18 in. long.

What would be the effect of having more than one raceway enter the box on the angle pull? The following will illustrate the problem.



The minimum distance "A" is still governed by the largest conduit so that it will have to have a minimum value of 6 times 3 or 18 in.

However, the rule requires that



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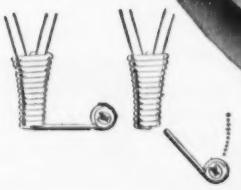

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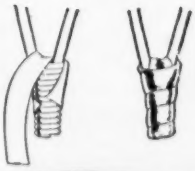

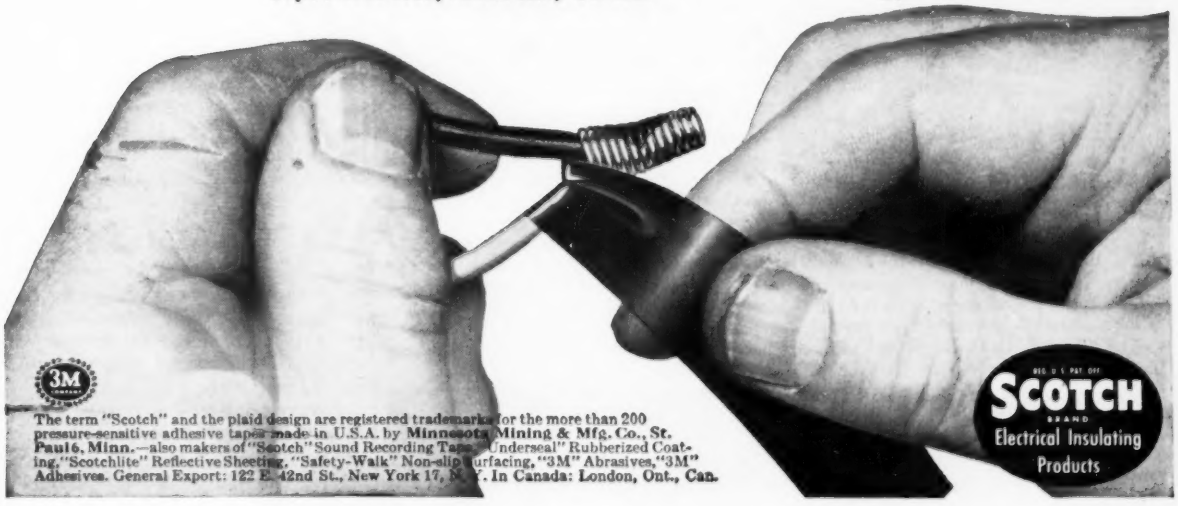

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this "distance be increased for additional entries by the amount of the sum of the diameters of all other raceway entries on the same wall of the box." Some inspectors have rules that since the phrase "all other raceway entries" is used, all sizes, including those smaller than 1¼ in. must be included. Others have ruled that the primary requirements as set up exclude all raceways smaller than 1¼ in. and also all raceways larger than 1¼ in. containing conductors smaller than No. 6. We will include all conduits in our calculations since there is only one involved and actually it will not have too much effect on the final result. So that the actual minimum dimension of "A" will be

$(6 \times 3) + 3 + 2\frac{1}{2} + 1$ or $24\frac{1}{2}$ in.

In this case getting the 6 times trade diameter minimum dimension for "B" for the 2½ in. conduit will for practical purposes give the proper minimum distance for the 3 in. conduits. The minimum value of "B" will be:

$6 \times 2\frac{1}{2}$ or 15 in.

The minimum value of "C" will be

15/1.42 or $10\frac{1}{2}$ in.

Add to this one half the dimension of a 2½ in. locknut, or ½ of $3\frac{1}{2}$ or $1\frac{3}{4}$ in. Two, three inch locknuts must also be added so that we have $2 \times 4\frac{1}{4}$ or $8\frac{1}{2}$ inches.

Exclusive of the ⅛ in. or so clearance between locknuts we have $10\frac{1}{2} + 1\frac{3}{4} + 8\frac{1}{2}$ or $20\frac{3}{4}$ in.

This is less than the minimum calculated above so the minimum dimensions for this box would be 24 in. x 5 in. x 24 in.

It should be noted that had one more 3 in. conduit been set into the box, the minimum dimension by the second set of calculations would have been $10\frac{1}{2} + 1\frac{3}{4} + (3 \times 4\frac{1}{4})$ or 25 in.

In this case our box, to have sufficient room between the locknuts would have to have the following minimum inside dimensions: 26 in. x 5 in. x 26 in.

It should be noted that two general exceptions are provided. One applies to the junction box housing motor terminals supplied with the motor. In many cases these are entirely too small and are often replaced in the field by larger junction boxes, dimensioned in accordance with the above requirements.

The second exception applies to the use of such conduit fittings as "LBs", "Ts", etc. Here, again good judgment and good engineering may dictate the use of the mogul or extra large types of these fittings, or the substitution of special boxes designed as outlined above.

Paragraph b of the section applies to all pull boxes and junction boxes. In other words if a pull box is longer than 6 feet and no wires larger than

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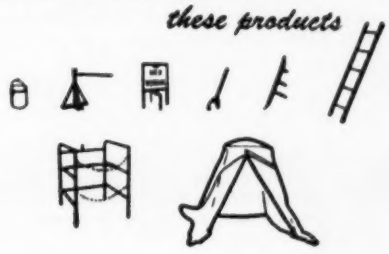

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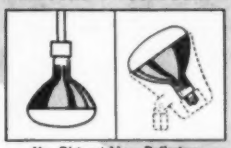

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No. 8 are entering the box, these conductors shall be either cabled or racked in a manner acceptable to the local code enforcing authority. Similarly, even smaller conduits than 1¼ in. size are entering this long pull box, this requirement for racking or cabling applies.—B.Z.S.

Multiple Service Switches

Q. *We have been awarded a contract on a Federal Housing Project and one paragraph of the specifications reads as follows: "Branch circuit panels shall consist of the required number of protective devices and required main disconnects. Main disconnects are not required on circuit breaker panels consisting of not more than six branch circuit breakers."*

Another paragraph in the same specifications is as follows: "Main disconnecting means shall be of circuit breaker type or pull-fusetron type, except that main disconnect is not required on circuit breaker panels consisting of not more than six branch circuit breakers."

Our local inspector claims there is no place in the National Electrical Code that approves this and is insisting on a main disconnect ahead of a six circuit breaker panel.

Please inform me what paragraph or page in the National Electrical Code gives this information as we do not intend to put a main breaker ahead of the breaker panel.—J.G.J.

A. Section 2351-a of the Code recognizes, as a means of disconnect for a service, six switches or six circuit breakers provided they are in a common enclosure or in a group of separate enclosures, located at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall. In addition this multiple disconnecting means must be of a type *approved* for service equipment and for prevailing conditions.

Section 2371-a-2 of the Code likewise recognizes the use of six circuit breakers or six sets of fuses to act as the overcurrent protection for the service entrance conductors. If all of the foregoing provisions are satisfied, I see no objection to the use of a six circuit panel, containing either circuit breakers or fused switches as the main service disconnect, provided the assembly is approved by Underwriters' Laboratories for service use.

Since this is a housing project, which involves multiple occupancy, it appears that other considerations may be concerned with the ruling.

—B.A.McD.

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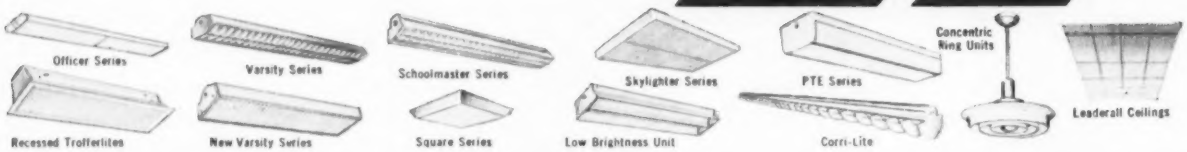

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Modern Lighting

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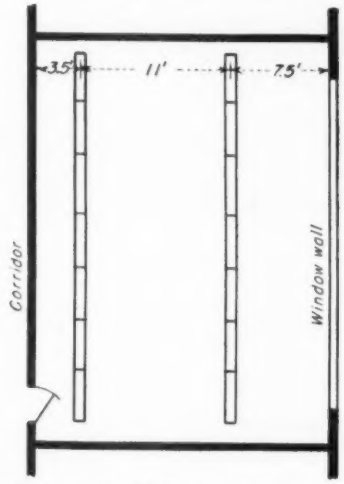

UNEQUAL SPACING of luminaire rows is used to provide approximately even intensity of illumination on all desks during daylight hours.

The luminaires are Sylvania Trimline louvered units, Type CL-242 bi-pin instant start type, suspended 15 inches from the ceiling in two continuous rows. There are seven 4-foot 2/40-watt lamp units in each row, or a total of 14 luminaires and 28 40-watt Sylvania Warmtone lamps per classroom.

Assuming that the two rows of luminaires light the entire classroom from wall to wall, as is the case at night, the *average* maintained intensity of illumination is estimated at 29.4 footcandles, using a coefficient of utilization of .42 and a maintenance factor of 70%. Actually, the intensity on desk tops at night is above 30 footcandles for all desks except the row of desks adjoining the window wall, where it drops to considerably less than 30 footcandles. But during daylight hours, daylight raises the intensity of light on the desks adjoining the window to considerably more than 30 footcandles. Daylight and sky brightness through the windows are controlled by means of venetian blinds.

The fluorescent relighting program at Love School was planned by the engineer for the Jamestown Board of Education in cooperation with Sylvania lighting engineers. This lighting has proved to be so satisfactory that the Board of Education officials have expanded the program to other schools in the Jamestown school system, using the same basic lighting plan for all classrooms.

TWO CONTINUOUS ROWS of Sylvania louvered fluorescent luminaires supplement daylight in classrooms at Love School, Jamestown, N. Y., to provide in excess of 30 footcandles of illumination on all desk tops, thereby meeting the minimum standards of the IES-ASA Recommended Practice of School Lighting.

Floor-Level Servicing for Balanced Fixtures

Cleaning and servicing of fluorescent lighting fixtures by regular plant maintenance personnel working at floor level is now possible through the use of a simple counterbalancing device which may be incorporated in any size of commercial or industrial fixture. Power is automatically interrupted when the fixture is drawn down from its normal mounting position, thereby permitting the worker complete protection from the hazard of shock.

The balancing device consists of an elastic spring arrangement which is treated in production so that its normal "relaxed" form is a tight coil. This coil is wound on a storage bushing (shown on the right in the circular insert). As the fixture is pulled downward, the coil is wound from the storage bushing to an "output" bushing carrying the cable drum. Since the nature of the coil is such that it is constantly attempting to return to its relaxed position on the storage bushing, a constant counterbalancing force is provided to support the fixture at any desired elevation.

This means that the fixture can be lowered to the most convenient height for the maintenance men who clean reflecting surfaces, relamp the unit or replace starters. The counterbalancing

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SLIMLINE FIXTURES
FOR EVERY REQUIREMENT...
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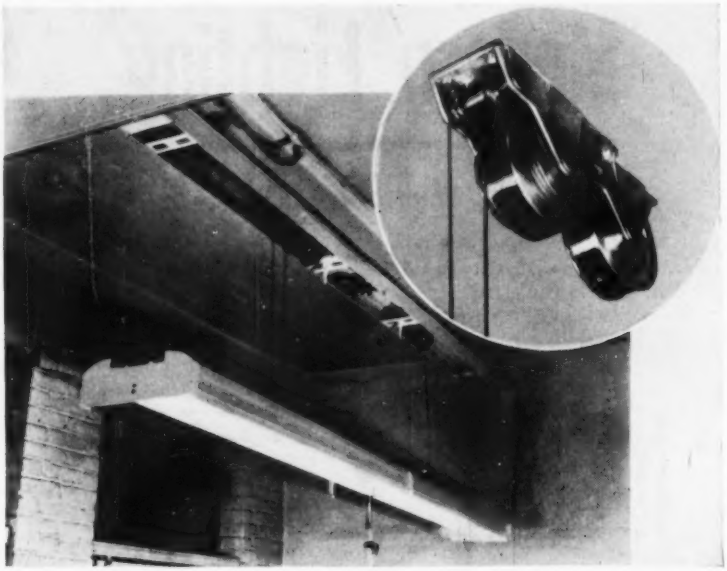


COUNTERBALANCE devices built into channel of lighting fixture permits unit to be lowered to any convenient height for servicing, automatically disconnects the circuit and facilitates raising the unit back into position.

device occupies little space; it is neither bulky nor heavy, and it may be readily built into the housing of a fixture.

The balancing device was developed by the Hunter Spring Company of Lansdale, Pa., while the fixture here shown was developed jointly by The Thompson Electric Co. of Cleveland and Curtis Lighting, Inc., of Chicago, Illinois.

Lounge-Bar Combines Coves, Downlights

The judicious use of coves, valances, niche and downlight, together with the application of appealing color combinations and natural wood panelling, helps create a relaxing, friendly atmosphere in the tropic-muralled informal lounge-bar of the Milwaukee Athletic Club.

As indicated in the accompanying illustrations, general illumination is evenly diffused, provided by reflected light originating in the parallel coves that encircle the domed acoustical-plaster central ceiling area.

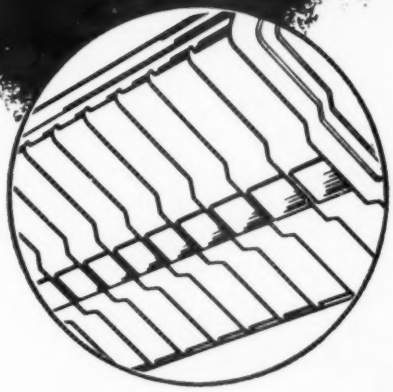
Concealed valance striplights above murals highlight interesting jungle scenes, while sparkling glassware is

VARIETY OF LIGHTING TREATMENTS are used in this lounge bar in accordance with desired esthetic, decorative or functional intensities. Recessed downlights improve visibility over bar, work areas and lounge tables.

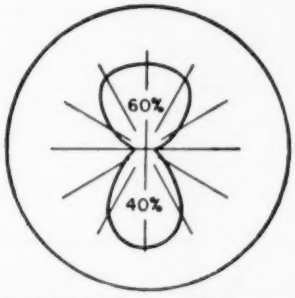
Years Ahead **IN DESIGN**

Wheeler FLO-LINER

THE NEWEST ADVANCE IN FLUORESCENT LIGHTING FIXTURES FOR SCHOOLS, OFFICES, STORES AND PUBLIC BUILDINGS



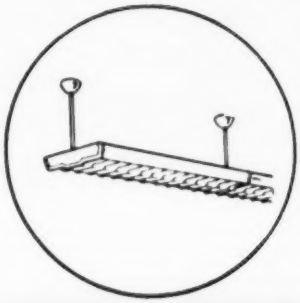
Tomorrow's fixture *today* — the new Wheeler FLO-LINER combines high efficiency and smart styling with unique maintenance ease and economy. When detached, louver assembly is automatically suspended below channel by supporting chains — allows quick, easy access to operating equipment. Amazingly flexible — 2 lamp and 4 lamp units available for both single pin and bi-pin lamps!



45° CROSSWISE SHIELDING — provided by the unique use of a plastic center panel which gives comfortable shielding to this shallow, smartly styled unit.

85% EFFICIENCY — translucent plastic side panels and center panel give low brightness for more comfortable seeing and high efficiency. For further seeing comfort, 51% of the light is directed above the horizontal and 34% below.

Write for special **FLO-LINER** *bulletin*



EASILY JOINED — in continuous rows by simply joining ends together with two screws which are supplied. Units may be suspended from pendant stems or attached directly to ceiling.

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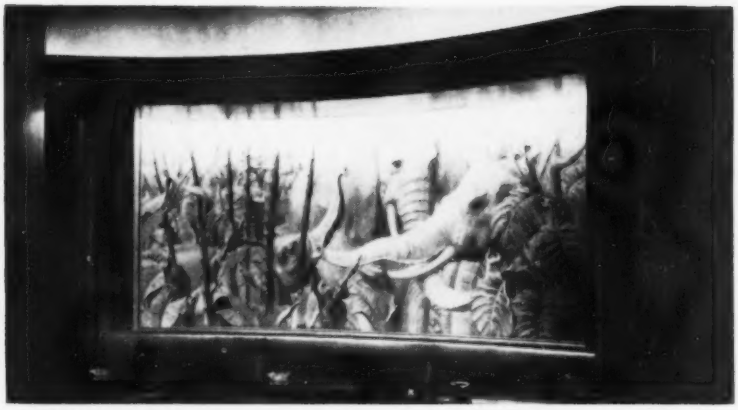

COLORFUL MURALS, depicting tropical vegetation and animals, are illuminated by overhead fluorescent striplights concealed by natural wood valances. Indirect ceiling lighting is provided by parallel coves.

top-and back-lighted by a similar strip installation running behind the upper lip of niche spanning rear bar shelf.

The top of the bar, the mixing and washing areas immediately behind it, and the circular tables at the corners of the lounge, are all illuminated by recessed circular downlights.

With this pleasing combination of fluorescent and incandescent treatments, illumination levels average 12-footcandles in the central area beneath the domed ceiling, 20 fc on table tops beneath downlights, 30-fc along the bar, and 75-fc in the glass display niche.

100 Footcandles In Drafting Room

A new fluorescent lighting installation now provides 100 footcandles of well-diffused, comfortable illumination throughout the drafting room at Lockwood-Greene Engineers, Inc., Spartanburg, S. C. A previous condition of shadows and spotty light no longer exists, and desk lamps are unnecessary.

Lighting design in this area was engineered to achieve specific lighting effects. Four-foot, louver-shielded Sylvania fixtures, each equipped with two 40-watt cool white lamps, are mounted in six continuous rows. Five of the rows contain 12 fixtures; the other contains only ten units due to the existence of room columns in the line of the run. The fixtures are suspended one-foot from the ceiling, 5-feet 2-inches above the working plane, with the rows lined-up along the side edges of the six-foot long drafting boards. Where aisles and storage tables are located, the distance between rows is increased to 6-feet 9 inches.

In addition to the high lighting intensity effected by the fixtures themselves, high light reflection from the room's surfaces also adds to the visual environment. In this drafting room, the acoustical tile ceiling has a reflection factor of approximately 85%; the green walls, approximately 80%. Overall, the lighting result conforms closely to the best recommendations for this type of interior.

LIGHTING FULLNESS in this drafting room is the result of high room surface RFs and louvered fixtures which afford a 100 footcandle level.

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Moran Electric Service, Inc.
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Proof of Higher Sales Records!

Read how these Electrical Contractors boosted their business with Sylvania's powerful promotion. You can, too!

The enthusiastic comments on this page are typical of scores we have received from Electrical Contractors all over the country praising the sale-boosting power of Sylvania's Qualified Lighting Contractor Business Building Program.

It's a 3-part Program

The full program consists of (1) National ads and a great popular television show, (2) a planned publicity campaign, (3) a personalized direct mail campaign.

It all features the striking, colorful Qualified Lighting Contractor Emblem. This ties in with full-page ads in Time, Business Week, Newsweek and other magazines. It's also displayed on the great TV show "Beat the Clock."

Also, this emblem, in decal form, is to be displayed on your trucks and in your store windows. It's carried in all the hard-selling direct mail folders and material which Sylvania mails to your prospects.

Sorry we haven't the space here to go into all the many details of this promotion. But, believe us, it's a complete program that follows through . . . from attention-getting ads to zooming sales! The coupon brings you full information and sample brochure. Mail it NOW!

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In June of 1950, Mr. C. W. Stetson and Mr. Ted Stetson, heads of the Stetson Electric Company, turned to WESCO when their company was awarded the contract on the Statler project . . . the largest single order they had ever tackled! Overnight they had an urgent supply problem. Staggering amounts of electrical apparatus and supplies were called for. The problem of supply was acute in view of the Korean situation. The Stetson Company evidenced their confidence in WESCO's ability to supply their material requirements by placing a blanket order for the entire project.

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In The News

EMEA of So. California Holds Conference

Emphasis was on the five phases of an electrical maintenance engineer's job as the Electrical Maintenance Engineers Assn. of Southern California this year concentrated on a conference instead of a show, March 18-20, at Rodger Young Auditorium, Los Angeles. Five panels of experienced men conducted the forum type conferences which some 160 attended and selected the subjects upon which they wanted information. The conference started with a dinner meeting attended by 346.

H. R. Meyer, manager of Maintenance Sales for Westinghouse Electric Corp., Pittsburgh, was the principal speaker at the dinner. "Don't let your management be caught with their plants down," he said, might well be the theme of the conference. "Our research and design engineers can conceive an idea, lay it out on the drawing board, see that it is correctly built in the manufacturing aisles and to a great extent assist its installation. But it takes the maintenance engineer to see that it is kept running with a minimum of down time and a maximum of efficiency for quality control.

"The old idea of waiting for equipment to break down and then repair it has been replaced with a new concept of preventive maintenance."

Meyer also set the theme of the conferences by showing the importance of maintenance in conserving materials and resources, telling of developments that reduce maintenance—such as glass fiber insulations, silicones, thermoplastic coils, prelubricated bearings, all-steel motor frames, etc. The "screwdriver and oil can type" of maintenance is being replaced by 1. a skilled maintenance organization; 2. a schedule of inspections and 3. a willingness to take care of troubles before they occur.

Each of the five panels ran three consecutive and similar sessions on Thursday morning and afternoon and on Friday morning. At each session the panel members first presented a short resume of some phase of the major subject. At the end of these talks the remaining time was spent in questions and answers and exchange of experiences or methods. Any three of the five subjects were thus available to any registrant for the conference, or he could split his time among the panel groups as he chose.

Maintenance Records, Planning and Scheduling, was the phase covered by panel 1, of which John J. Singleton, chief electrician, Lever Bros., was chairman. On the panel were R. H. Disterdick, engineer and instructor of industrial organization; H. M. Evers, plant engineer, McCulloch Motors Corp.; Henry Schumacher, chief electrician, Richfield Oil Corp.

Lighting Maintenance was the subject of panel 2, with Jack C. Cochran, building superintendent, General Petroleum Building, chairman, aided by Benn J. Hartmann, manager Flood-Lite Service, Inc.; Robert Marcum, supervisor, engineering records group, plant engineering, Hughes Aircraft Co.; and Foster K. Sampson, electrical and illuminating consultant.

Maintenance of Electrical Equipment in Industry was panel 3's subject. L. J. Rejda, maintenance engineer, Westinghouse Electric Corp., was its chairman as well as the general chairman of the conference. On his panel were E. J. Butland, general foreman, maintenance department, Lockheed Aircraft Corp.; Floyd Mayfield, foreman, electrical department, Standard Oil Co. of Calif.; and R. C. Samuels, assistant chief engineer of maintenance, American Potash & Chemical Corp.

A second panel on the same subject was headed by George Larsen, electrical engineer and partner, Larsen-Hogue Electric Co. On the panel were Ray D. Dingler, in charge of electrical

EXPERT CODE PANEL takes on all questions at all-industry meeting of electrical group in Minneapolis. Panel members (L to R): Martin Sneed, chief electrical inspector, Minneapolis; Glenn Rowell, electrical engineer, Fire Underwriters Inspection Bureau, Minneapolis; Ben Lipinski, State electrical inspector; George Reed, electrical instructor, Dunwoody Institute, Minneapolis.

PROMINENT LIGHTING ENGINEERS bring research and application progress reports to electrical industry convention in Minneapolis. On session panel were (L to R): session chairman Don Greene; Larson & McLaren; Dr. S. K. Guth, General Electric Co.; H. W. Grosh, Westinghouse Lamp Division; R. R. Wylie, Sylvania Electric Products Company.

Rakit, the easiest-to-assemble system of supporting structures ever devised, now offers a revolutionary one-piece bracket. This features even greater simplicity of installation by the twist-of-the-wrist method with more assembly time saved. No bolts, nuts or other fasteners are required.

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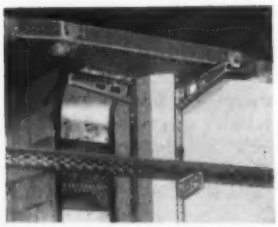

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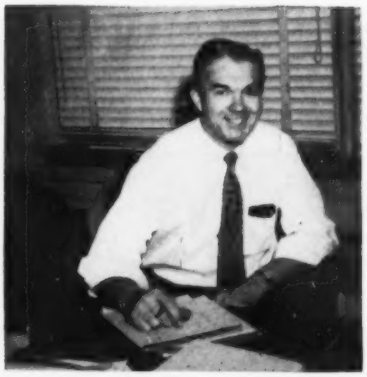

IN CHARGE OF Western operations of the Howard P. Foley Company, C. I. Berrell, Jr., vice president, brings some 19 years of electrical construction experience to the Utah area. He headquarters at Salt Lake City.

design, construction and maintenance, Monolith Portland Cement Co.; Ernest F. Donatic, general superintendent in charge of service, Kaiser Steel and R. J. Kernaghan, foreman, electrical department, Goodyear Tire & Rubber Co.

Special Instruments, Tools and Methods Used in Maintenance was the subject of panel 5, with Jack B. Pitts, plant electrical engineering, Shell Oil Co. as chairman and the panel consisting of Howard Miller, engineer, customer equipment service, Los Angeles Department of Water & Power; Elmor M. Croft, owner, Croft Electrical Laboratories and Paul Henrichs, assistant industrial power engineer, Southern California Edison Co.

Richard Rogers, Ace Day & Night Electric Co., president of EMEA, announced at the dinner meeting that the customary industrial electrical show, set aside this year, will be staged next year in March at the Shrine Auditorium.

The conference committee, headed by Rejda, had on it Jack Cochran, George Larsen, Jack Pitts, John Singleton and F. J. Rohring.

Lynchburg Stages Modernization Conference

Two conferences, for store owners and industrial plant management respectively, were held under the auspices of the Lynchburg Chamber of Commerce at Lynchburg, Virginia on April 22 devoted to lighting, air conditioning and painting modernization. The conferences climaxed a civic campaign "Light up—Paint up—Clean up."

A panel of experts—A. A. Farnham, engineer, Roanoke; R. B. Chipman, General Electric Co., Norfolk; Harry S. Freer, Dupont Co., Philadelphia; J. B. Benson and Joseph Grenader, Carrier Corp.—discussed the current technology of each field and its application to practical commercial and industrial modernization. W. T. Stuart, editor, *Elictrical Construction and Maintenance*, in summarizing each of the conferences, emphasized the coordinating role of adequate wiring and the importance of "planning boldly" for continued growth.

William J. Novak Joins EC&M Editorial Staff

Electrical Construction and Maintenance has added an assistant editor, William J. Novak, to the editorial staff. Bill is a graduate of Illinois Institute of Technology in Chicago, Illinois, holding a B. S. degree in electrical engineering. From 1943-1946 he served with the U. S. Army Signal Corps, including overseas duty in Puerto Rico. He was recalled to active duty from the Reserves in 1950 with a photographic unit, returning to civilian life in April, 1953, after a ten-month tour of duty in Korea with the 45th Infantry Division as Wire Operations Officer and Signal Supply Officer.

When he was not "employed" by the U. S. Government, Bill was an electrical engineer with International Harvester Company's McCormick Works in Chicago, where he handled industrial power and lighting system design and acquired practical on-the-job experience with electrical construction, installation and maintenance problems. His writing experience includes the preparation of technical papers on electrical equipment. He has also done electronic repair and balancing work for Zenith Radio Corporation in Chicago.

WILLIAM J. NOVAK

MUTUAL INTEREST in an electrical problem is shown by: (L to R) David K. Evans, electrical engineer, Capital Electric Co., Madison, Wisconsin, project electrical contractor, and Frank J. Turnquist, maintenance engineer at Gardner Baking Company's new Madison plant.

Bill is a member of Eta Kappa Nu electrical engineering fraternity.

He is an expert photographer and plays a piano with professional skill. He will soon be travelling the country with notebook and camera, running down technical articles and news for the readers of *Electrical Construction and Maintenance*.

Materials Handling Conference and Show Scheduled For Philadelphia

A group of 42 speakers, representing many of the outstanding industries in the country, will head workshop seminars at the Materials Handling Conference which will be held concurrently with the fifth National Materials Handling Exposition at Convention Hall, Philadelphia, May 18 to 22.

This exposition the largest capital goods industrial show to be held anywhere in the country during 1953, will display thousands of new materials handling equipment models having a total valuation of approximately $10-million. Over 3000 engineers will also be on hand to answer questions of visitors at the show, Machines on display will include lift and fork trucks, both battery and gasoline powered, conveyors, both permanent and portable, hoists, monorails, cranes, tractors, trailers, hand trucks, stacking units, portable elevators, skids, pallets and their associated accessories.

The conference, described as a "work shop" for engineers, maintenance

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Fast, versatile and so easy to use — Blackhawk Benders speed every job!

Yes, sir, you can pump from any spot — on the floor, on the bench or up on a ladder — even while you're moving around! That's because with Blackhawk "Porto-Power" Pipe Benders the hydraulic pump is separated from the bender by a flexible safety hose.

But that's only one of the big "dollars and horse sense" reasons why so many contractors choose Blackhawk Benders to speed their work. Models are available for any popular size conduit, rigid or thin-wall. Then, too, they can use the same Blackhawk "Porto-Power" hydraulic jack for hundreds of lifting, pulling or pushing jobs.

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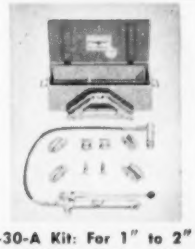

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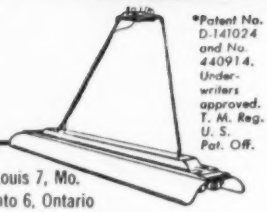

*Patent No. D-141024 and No. 440914. Underwriters approved. T. M. Reg. U. S. Pat. Off.

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02

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nance men and executives in the field, will include discussions of general problems of materials handling in addition to seminars on "Handling in Process", "Warehousing and Shipping", "Packaging for Improved Handling", "Bulk Handling" and "Requirements for Organized Study and Analysis".

Conference sessions will take place from 9 a.m. to noon on three of the five days of the show, thereby permitting visitors to spend nine hours in a discussion of a single subject or three hours on each of three separate subjects. Since most of those attending the conference will be authorities in their own right, these sessions are expected to provide many important new ideas on handling problems.

Acting as sponsor for the exposition will be the Materials Handling Institute, the organization of materials handling manufacturers. The American Material Handling Society, composed of executives of companies using mechanical handling systems, will conduct the concurrently-run conference and will tender a banquet to visitors.

Advance registrations and reservations indicate that all available display space at Convention Hall has already been assigned, and more than 25,000 visitors from 40 countries are expected to attend.

Contractors Promote Business With Folder

Electrical contractors in and around Philadelphia, Pa. are using a new advertising folder, to promote business for themselves by selling the public on the idea of first calling in an electrical contractor when in need of electrical equipment or electrical services of any kind. The idea of using

GOLDEN JUBILEE AWARD certificates representing 50 or more years of service in the electrical industry are received by contractor John Salfer (center), Mankato Electric Co., Mankato, Minn.; and electrical inspector John W. Keyser (right) of Slayton, Minnesota. Presentation was made by Harry S. Davis, secretary, North Central Electrical Industries at recent convention in Minneapolis.

GEORGE W. ABBETT, president, Abbett Electric Corp., San Francisco, checks progress sheets on a multi-million dollar electrical installation his firm is making at the new U.C.L.A. medical center in Los Angeles.

folders for direct mail promotion is not new, but the message in the folder is a new approach to this problem.

Developed exclusively for the use of the contractors, the new folder was designed through the cooperation of The Electrical Association of Philadelphia and the Philadelphia Electric Company, working with an unofficial business promotion committee representing the five unaffiliated electrical contractor associations in the Philadelphia area. Its title is "For a Complete Electrical Job With Complete Satisfaction . . . Consult First with a recognized *Electrical* Contractor". Its main theme emphasizes the many advantages of consulting with a recognized electrical contractor before purchase of any electrical equipment. Prospects for contractors' services are told that complete satisfaction in purchase, installation and maintenance of equipment is assured when the entire job is placed in the hands of a reputable electrical contractor.

The folder measures 3¼ in. by 6 in., is attractively printed on a white glazed stock in orange and black colors, and opens out to four pages 6 in. by 6½ in. One half of the rear page has been purposely left blank for imprinting of contractor's name or association. It is styled to fit the conventional business envelope, and may be used as a direct mail advertising piece, or as a bill stuffer. It is being printed and made available to the contractors through the Philadelphia Electric Company at cost.

Participating in the development and use of this folder are the following electrical contractor associations: Independent Electrical Contractors Association, Pen-Del-Jersey Chapter of NECA, Delaware County Electrical Contractors Association, Bucks-Montgomery Section of the Electrical Association (Philadelphia), and the Contractors Division of the Association.

"Dongan" CONTROL TRANSFORMERS

USED with remote control equipment, including all types of magnetic switches, recording devices, relays, solenoids, thermostat controlled devices, small motors, variable speed devices, control valves for fluids, gases—and for all other purposes where lower than available line voltage is required.

Other Types of "Dongan" Transformers

Machine Tool, Power Circuit, Signaling, Oil and Gas Ignition Transformers.

Write for New Catalog

PROMPT SHIPMENT

DONGAN ELECTRIC MFG. CO.
2980 Franklin St. Detroit 7, Mich.

The Dongan Line Since Nineteen-Nine

A Journeyman's Tool, built to stand up under constant, on-the-job Contractor or Industrial use

● **NO STARTING HOLE NEEDED**...Simply place guide next to material and "rock" tool into an upright position.

● **CUTS RIGHT THRU IMBEDDED NAILS** . . . wood, plaster, iron pipe, sheet metal, "Transite" and most other materials—even in cramped quarters.

● **FITS ANY HEAVY DUTY ¼" or ⅜" DRILL**...as easy as changing bits! Overall length only 10¾"; weight only 3 lbs. 6 ozs.

● **ANTI-FRICTION REPLACEABLE BEARINGS—BUILT-IN BLOWER** . . . Blower keeps tool comfortably cool even under continuous use—blows dust and chips away from cutting line. All friction surfaces are of "Oilite," phosphor bronze or high speed ball bearings. All wearing parts are replaceable.

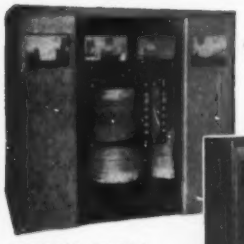
Write for Bulletin No. Y-5.

Cutting opening in oak flooring in less than 3 minutes—no starting hole needed!

R.C.S. TOOL SALES CORPORATION Joliet, Illinois, U. S. A.

Federal Procurement Officials will find Super Saws listed in Federal Supply Schedules, Class 40 Materials.

WANT the BETTER* TRANSFORMERS?



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DISTRIBUTION TRANSFORMERS (DRY TYPE)

We build them . . . with modern materials and engineering techniques . . . plus up-to-date design . . . based on years of experience.

Here is a typical air-cooled 500 KVA class B type. 80°C Rise. 3 phase 4160 Delta Primary + 2½% full capacity taps. 240x480 Delta Secondary. Available from 30 to 2500 KVA with voltages from 2400 to 15 KV.

DRY TYPE
Indoor or Outdoor
3 KVA to 15 KVA
Air-Cooled

® MAGNATRAN

MEETS STANDARDS OF AIEE-NEMA

WRITE FOR DETAILS

*If you think this is just an advertising adjective we invite you to contact us . . . we will tell you who buys Magnatran—the better transformers . . . and if you want, show you how we build them.

A NAME SYNONYMOUS WITH EXPERIENCE

MAGNATRAN INCORPORATED

TRANSFORMERS AND ELECTRICAL EQUIPMENT

WALTER GARLICK, JR., PRESIDENT

246 SCHUYLER AVE., KEARNY, NEW JERSEY

MAGNATRAN ®

ELECTRICAL ENGINEER Mel Cammisa (center) of the Charles A. Langlais Co., San Francisco electrical contractor, highlights electrical system design feature of Stonestown's new shopping centers to Griswold Raetz (left) supervising architect for Wilton Becket and Associates, and Langlais' electrical superintendent Chick Terrill at right.

Massachusetts ECA Appoints Officers

At the 19th annual meeting of the Massachusetts Electrical Contractors Association, held in April, John J. Reddington, president of J. J. Reddington Electric Service Co., Boston, was elected president. He succeeds William H. Hughes, Hughes Electric Service Co., Watertown, Mass., who was named first vice president.

Ernest Tucker of the Tucker Electric Co., Randolph, was elected second vice president, and John R. Lentine, Jamaica Plain, was named secretary. B. D. Goss, Cambridge, was re-elected treasurer.

Peter DiPirro, Charlestown, and Gerard G. McDuff, Peabody, retiring secretary, were elected directors to serve with Robert F. Black, Dorchester, Nathan Rabin of Boston, and Bernard F. White, Roxbury, who were returned to the board.

The new officers and directors were installed at the association's annual dinner May 7 at the Hotel Somerset, Boston.

NISA NEWS

Ontario Chapter held its regular meeting March 14 at the King Edward Hotel in Toronto. Following committee reports, the group heard a report on apprenticeship training and discussed a future meeting with one of the NISA chapters in the United States.

• • • •

Central District Chapter met March

ROYAL

ENGINEERED FUSES
for dependable
protection

ROYAL-NOARK
NON-RENEWABLE
5
ways better
on the
inside

use them on
EVERY JOB

ROYAL-NOARK
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easiest
to
renew

Engineering improvements in the design and construction of ROYAL-NOARK cartridge fuses mean that they stay cooler . . . give greater protection to vital equipment.
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ROYAL
Quality
WIRE • CARTRIDGE FUSES
famous ROYAL "Crystal" PLUG FUSES
ROYAL ELECTRIC CO., INC. PAWTUCKET, R. I.

J. S. VAN ALSTYNE, co-owner of Van Alstyne & Son Electrical in Sacramento, California, is a strong proponent of detergent cleaning of motors; will not use a flame to remove old windings. His motor repair firm is distributor for eight electric motor manufacturers; does considerable repair work for government agencies.

10th at the Tower Club in Chicago to hear Frank Susar, supervision engineer, Loss Prevention Dept., Liberty Mutual Insurance Co. discuss "Hazards in Your Shop." and Bart Wright, Howell Electric Motor Co. talk on "Torque Motors."

• • • •

The Mid-Year Convention of the Southwestern Chapter was held March 20-21 in Fort Worth, Tex. at the Worth Hotel. Members and guests saw movies shown by the Bell Aircraft Corp., Fort Worth, entitled "Utility Unlimited" and "Mercy Has Rotary Wings." Dr. Ralph Clayton, radiologist, Parkland Hospital, Dallas, spoke on "Atomic Weapons—Possibilities and Limitations". Sixty-three attended.

• • • •

Mid-South Chapter held its quarterly meeting in Nashville, March 14, at the Andrew Jackson Hotel. The morning session was devoted to administrative and management problems including a session on methods and procedures for collecting accounts. Following lunch, the group saw a 30 minute movie on metallizing techniques presented by the Metallizing Engineering Co. George Treiber spoke on varnish and baking.

• • • •

Indiana Chapter held its regular meeting March 5th at the Delaware Hotel, Muncie, Ind., the meeting being sponsored by Cliff Buennagel, the Universal Electric Co. Muncie. The meeting began with a luncheon, followed by a business session.

New officers are president, Walter Kayser, Wayne Electric Co., Fort Wayne; vice chairman, John M. Foulke, Electric Motor Service Co., Indianapolis; secretary, Burt Hanne-

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RIGHT CONTACT
for dependable
wiring devices

CAPS

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CONNECTORS

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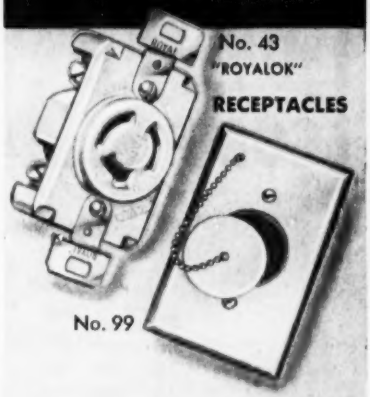
use them on
EVERY JOB



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"ROYALOK"
RECEPTACLES

No. 99

Sound engineering, quality materials, and experienced manufacturing skill make ROYAL wiring devices better for you these three ways: 1) they're easy to wire; 2) always dependable; and 3) long life under constant use.
. . . ask your wholesaler

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Quality
WIRE • CARTRIDGE FUSES
famous ROYAL "Crystal" PLUG FUSES
ROYAL ELECTRIC CO., INC. PAWTUCKET, R. I.

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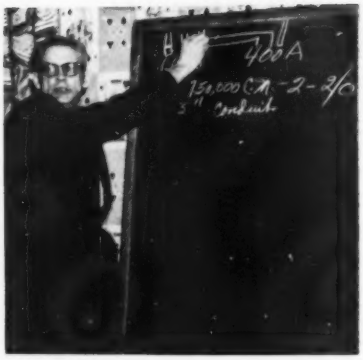
MARATHC
Largest STOCK
RENEWAL PARTS
IN THE WORLD
FOR ALL MAKES OF
ELECTRIC MOTORS & CONTROLS
COMPLETE READING ELECTRIC CO., INC.
100 SOUTH JEFFERSON STREET • CHICAGO 6, ILLINOIS
"Your Best Source of Supply"
COMPLETE ONE STOP SERVICE
FOR REPAIR SHOPS COAST TO COAST
• CUT
ALLEN-BRADLEY • LOUIS ALLIS • ALLIS-CHALME
MASTER • PEERLESS • ROBBINS &
DELCO • EMERSON
• GENERAL
• HOWELL



RAY BRAUN, executive secretary, Minnesota State Board of Electricity, doubles as a "faculty" member of the traveling estimating school sponsored by the Minnesota Electrical Association. His subject: field inspection problems.

wald, Scherer Electric Co., Indianapolis; treasurer, Glenn Buschman, Kirby Risk Electric Motors Inc. Lafayette.

After the business meeting the group toured the Ball Brothers Co. plant in Muncie, manufacturers of home canning supplies, then visited the new shop and supply warehouse of The Universal Electric Co.

• • • •

On March 13th the Niagara Chapter met for a dinner meeting at the Forty & Eight Club, which was attended by 24 members and guests. The program was very interesting and a pleasant evening was had by all.

The new officers elected were: Zip Lang, Jr., President, Lang Elec., Buffalo; Frank Eggloff, 1st V. President, Buffalo Elec., Buffalo; Bill Faltz, 2nd V. President, Faltz Elec., Rochester; Don Murray, 3rd V. President, S & S Elec., Buffalo; and Ralph Barker, Secretary, Treasurer, Barker Elec., Buffalo, N. Y.

Mr. Frosdick spoke briefly on the activities of the Chapter over the past few years relative to the various programs which have been presented and the value obtained from them and expressed the opinion that much good has been done to acquaint ourselves with the various means of acquiring greater knowledge for the betterment and the more efficient operation in the service that we render to the industry. He also spoke favorably in encouraging better disposition of the pamphlets recently made available for this purpose designed to acquaint the public with what our association really stands for as was covered by what it is, and what it does, its members, and how it serves industry.

• • • •

The March meeting of the Quaker City Chapter was an excellent one. Forty-two were on hand to hear Bill Weirich's interesting presentation of the story of Paper Insulation. He

MINERALLAC
"PULL-IN"
COMPOUND
No. 100

LISTED and APPROVED by UNDERWRITERS LABORATORIES

For Rubber, Synthetic, Plastic or Lead-Covered Wires or Cables

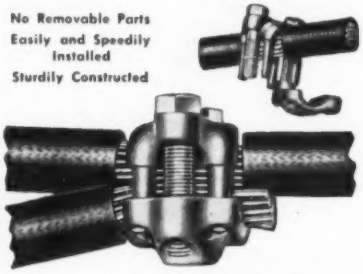
Approved by Underwriters Laboratories for lubricating wires and cables to facilitate pulling them into conduits. Not injurious to wire or wire covers. Free of objectionable odors. White in color. Will not drip or run. Conveniently packed in pint, ½ gal., gal. and 5 gal. cans. Available through your electrical jobber.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street, Chicago 7, Illinois
MINERALLAC

CLAMP and LOCK YOUR CONNECTIONS { THE K&H WAY

This
SWIVEL U-BOLT CONNECTOR
is designed to do just that...

No Removable Parts
Easily and Speedily Installed
Sturdily Constructed



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85% Copper Alloy • Ample Strength
High Conductivity • Unaffected by Vibration
Moisture Resistant
Sizes Up to 1,000,000 CM.
Approved by Engineers

Specify K&H for YOUR Next Job
For More Details, Sizes and Prices
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232-8 VINE ST. • CINCINNATI 2, OHIO

started with the history of paper and carried on through to the finished product and its advantages. It was very well done and the animated discussion that followed showed how interesting his handling of the subject was.

• • • •

Rudy and Mrs. Scherer plan to be in Vancouver April 1 and Seattle April 3, following their visits to other West Coast chapters and shops farther south.

Visitors to National Headquarters last month included Mr. and Mrs. G. E. Jones, G. E. Jones Electric Co., Amarillo, Tex., and Ray Guehne, National Electric Service Co. and secretary of Greater St. Louis Chapter.

• • • •

Jack Thompson, partner, Thompson Elevator & Electric Co., Chicago, and one of two organizers of the Chicago Central District Chapter NISA, died February 19, after a brief illness.

With the late Phil Guion of the Scott-Pillar Electric Co., Mr. Thompson organized 12 repair shops in 1922 into a local trade association whose membership reached 21 shops when it joined NISA as the Central District Chapter.

Thompson Elevator & Electric Co. will operate under Joe Borovec, shop superintendent; Bill Borovec, outside superintendent; and Steve Luga, sales manager. All three men have been partners in the company for many years.

• • • •

Installation of new officers of Metropolitan Chapter took place March 19. They are as follows: A. Shovan, Chairman; G. Lockwood, Vice-Chairman; H. Engelmann, Treas. and L. D. Ken-

MOTOR REPAIR SPECIALIST A. G. Lakore operates Lakore Electric Motor Repair, Inc., in Winona, Minn., and LaCrosse, Wisconsin. One of the first shop men to introduce mass production methods of rewinding fractional horsepower motors in that area, he increased his customer service by adding a V-belt and chain transmission drive sales-engineering department.

What makes "Sali" insulating bushings so Good?*

Write for Bulletin A

- Rugged, laminated phenolic material
- Designed for easy, quick installation
- Dependable insulation—lowest maintenance
- Undercut shoulder for snug fit to conduit
- Strong (NEMA) threads

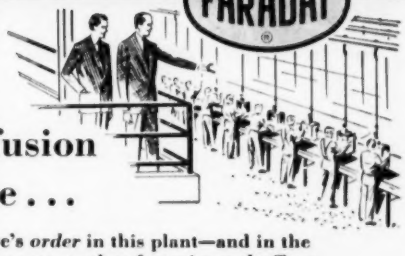
All sizes • All types • Prompt deliveries

** Superior Adalet Laminated Insulation*

THE Adalet MANUFACTURING COMPANY
14300 LORAIN AVE. CLEVELAND 11, OHIO

the Emblem of Quality since 1875

FARADAY



No Confusion here . . .

NECK-TYPE BELLS

VIBRATING HORNS

There's *order* in this plant—and in the many, many other factories and offices equipped with Faraday signals and systems. They stop confusion and save steps, paging and signaling clearly and faithfully, day-after-day, year-after-year.

For generations, Faraday engineers have designed bells, buzzers, horns, chimes and complete systems to meet an endless variety of signaling needs and sound level requirements.

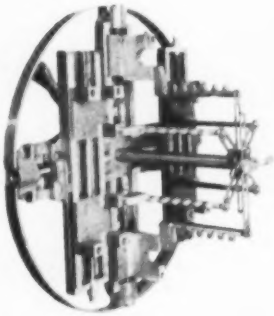
Consult your electrical wholesaler for details on the complete Faraday line.

HOLTZER-CABOT **FARADAY** STANLEY & PATTERSON

CONSOLIDATED BY:

SPERTI FARADAY INC. ADRIAN, MICH.

BELLS · BUZZERS · HORNS · CHIMES · VISUAL AND AUDIBLE PAGING DEVICES AND SYSTEMS



Far Ahead of the Field

P & R

Type GC Coil Winding

HEAD

The P & R Type GC Winding Head is without equal for efficient, accurate coil production. It embodies a cam collapse mechanism for all winding fingers which allows quick removal of coil groups and instantaneous repositioning for further winding. Winding fingers are set to coil dimensions by screw adjustment, and a complete set-up can be made in *less than two minutes!* Attachments are available for loop winding and single phase winding. Swivel End Finger attachment forms knuckles in the nose of the coils which remove strains, makes winding easier and reduces possibility of short circuits.

WRITE FOR FULL INFORMATION

Features with
EARNING POWER

- ★ Reduces Winding Time
- ★ Rapid Easy Adjustment
- ★ Fractional to over 75 HP Coils
- ★ Lifetime Service

POTTER & RAYFIELD, INC.
ENGINEERING CRAFTSMANSHIP
P.O. BOX 1042 ATLANTA, GA.

PAUL M. GEARY, executive vice president, National Electrical Contractors Association tells Minnesota electrical contractors at their Minneapolis convention, that the electrical construction industry needs a national federation of local organizations to gain its desired objectives.

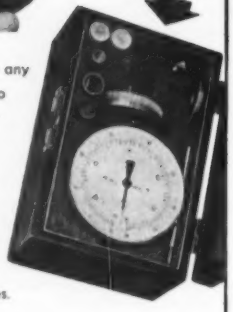
nedy, Secy. The Executive Committee consists of A. Bonahur, W. Kauppert, W. Lierer, J. Ryan, S. Bojak and W. Wheeler.

All the chairmen of various committees for NISA Convention met on April 2nd and final details of the program were worked out.

From Walter J. Prise, The Maintenance Co., New York, N. Y.

Control MAXIMUM PRODUCTION

with G. S. SPEED INDICATORS *and* HAND TACHOMETERS



1% Accuracy for any range from 30 to 100,000 RPM or surface speed.

Antimagnetic durable mechanism.

Efficient repair service at moderate charges.

IDEAL FOR MOTORS — SHAFTS SPINDLES — LOOMS — TURBINES FOR TEXTILE AND POWER PLANTS

WRITE FOR ILLUSTRATED FOLDER

GEORGE SCHERR CO., Inc.

200 EC LAFAYETTE ST. • NEW YORK 12, N.Y.

Richards-Wilcox

Electric Door Operators

for Residential • Commercial Industrial Installations

• *Convenient*
• *Practical*
• *Efficient*

For complete information, ask your jobber or write for R-W catalog A-87.

RICHARDS WILCOX R-W AURORA

Reg. U. S. Pat. Off.

Richards-Wilcox Mfg. Co.

150 Third Street • Aurora, Illinois

FCC Rules on Electronic Heaters

According to a report in *Electronics* magazine (May 1953), the Federal Communications Commission has ruled that industrial equipment which generates radio-frequency heat must be inspected and certified by a competent engineer before June 30, 1953. The required certificate must show that the equipment is sufficiently shielded and filtered to prevent interference to radio communication services and television, and that the equipment can be expected to remain in proper adjustment for at least three years. The certificate must be kept available for inspection by the FCC.

Book Reviews

Synchronous Machines

"Synchronous Machines, Theory and Performance," by Charles Concordia of the General Electric Company's Analytical Engineering Department, is a unified treatise of the fundamental circuit theories contributing to the transient performance of synchronous

machines. General equations developed are applied to the calculation of steady-state power, torque and current, both in starting and in sychronous operation, and of voltage disturbances occasioned by sudden applications of load. The book is written for those engineers who are directly concerned with the prediction of machine performance, and it is presented with the assumption that the reader has a reasonably intensive knowledge of both mathematics and the physical reactions of synchronous machines.

The book is developed progressively, with each chapter depending for complete understanding upon preceding portions. While a good portion of the material has been presented in other forms during the past several decades, Mr. Concordia has done a fine job in assembling and coordinating a large amount of information scattered through a large number of technical papers by various authors on such subjects as 3-phase short-circuit current, double-line-to-ground short circuit and sequential faults, voltage dip, starting torque and the like. There is no other book covering this field in this same comprehensive manner.

Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., the book includes 224 pages sized 6-by-9¼ inches, and it is priced at $5.50 in the U. S.; $6.88 in Canada.

Blueprints and Welding

Those who are actively engaged in the fabrication of machinery will be interested in the fourth edition of "Simple Blueprint Reading With Special Reference to Welding and Welding Symbols". In this book special attention is given to the use of welding symbols, yet it is intended as a general guide to a clear understanding of blueprints and how to use them in mechanical construction and fabrication.

Using a simple welded base as a study object, an explanation is made in step-by-step fashion of how the "sign language" of the blueprints is used to transmit information. After basic principles are explained, welding symbols and their use are fully described, and large clear drawings are used to illustrate each explanation. In order to promote intelligent visualizing of a print, numerous blueprints taken from actual shops are reproduced alongside photographs of the objects under discussion.

Such subjects as perspective and isometric drawings, sight projections, center plane lines, scales and sections, development of weld symbols, types

drills 6 inches of concrete per minute
...gives lowest cost per foot of concrete drilled with a
tilden
ROTARY
KONKRETE KORE DRILL
Patented core slot expels cuttings automatically
U.S. Pat. No. Re. 23539
Drill straight, clean, ready-to-use holes at speeds up to 6 inches per minute—even through steel reinforced concrete. TILDEN Rotary Koncrete Kore Drills can be used with ordinary electric or rotary air drill. Free Factory sharpening and repair service still available on all Standard TILDEN Drills from 3/16" to 8-inch diameters. Interchangeable shanks for any depth hole.
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SOLD BY SUPPLY HOUSES EVERY-WHERE
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with
SPRAGUE POWER FACTOR CAPACITORS
• CUT POWER BILLS
• AVOID EXTRA EQUIPMENT
• ALLOW BIGGER LOADS
• PROVIDE PLANT FLEXIBILITY
Thousands of installations throughout industry are proving daily that Sprague Power Factor Capacitors installed at each piece of inductive electrical equipment eliminate waste current right at the source. Power factor is corrected to the maximum, allowing a greater load at reduced power cost. Need for extra wiring, switchgear, and transformers is often avoided, and plant expansion or moves can be made at minimum cost. Write for Free 28-page Power Factor Correction Guide.
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SPRAGUE ELECTRIC CO.
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Please send me the free Sprague catalog "Power Factor Correction" (333)
Name ..... Title .....
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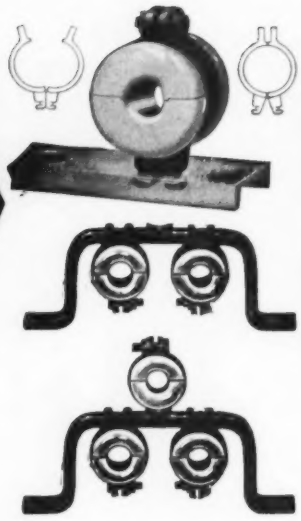
JUST SEND THIS COUPON FOR YOUR COPY

For QUICK, EASY, SAFE
Cable Installation
"EFFICIENCY"
NESTED
CONDUCTOR RACKS



Efficiency Nested Conductor Racks are simple, compact and are scientifically designed to carry conductors equidistant from center to center. One bolt supports the bushing, and clamps the bushing support to the frame. Available in 2-3-4-5 and 6-bushing racks.

Write for Catalog 38-A

Efficiency
ELECTRIC AND MANUFACTURING CO.
MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION
EAST PALESTINE, OHIO
"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

NEW PRESIDENT of the Minnesota Electrical Association, Rudy Salfer (left), Mankato Electric Co., gets a few pointers from retiring president Al Kohler of Hibbing. Rudy became president on the 25th Anniversary of the Association his father helped organize in 1928.

of welds and explanatory views are fully covered.

Published by The Lincoln Electric Company, Cleveland 17, Ohio, this 6-by-9 inch 207-page edition contains over 200 illustrations. With stiff board cover embossed in gold and bound in simulated leather, the book is priced at $1.00 in the U.S.; $1.50 elsewhere.

Polyphase Induction Machines

"The Nature of Polyphase Induction Machines" by Philip L. Alger, consulting engineer for General Electric's Small and Medium Motor Divisions, offers a thorough understanding of induction motor performance to students, designers and users of electrical energy. Based upon the author's 30 years of experience, the book thoroughly discusses the concepts of energy being received, stored, transformed and delivered through all aspects of motor performance. Complete formulas are derived for power factor, reactance, torque and magnetic forces, and methods are included for calculating locking, crawling, magnetic noises and voltage ripples. These results are presented in formula and in chart form.

Each phenomenon is first defined and explained through the mediums of equivalent circuits, harmonic analysis, rotating fields and energy flow theories, then the polyphase induction motor is analyzed in terms of principle of operation, performance calculations, design features, ratings and applications.

The text is illustrated by cross-sectional sketches of typical motors, performance graphs and tables, and a comprehensive bibliography is included for those who wish to investigate the subject further. Published by John Wiley & Sons of New York, the book measures 6 by 9 inches, contains 397 pages and is priced at $7.50.

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SMALL SIZE
weight
3 Lbs.

"MINOR"
MEGOHMER
PINT SIZE INSULATION TESTER
500 VOLTS DC GENERATOR

Range 0-50 megohms. True Ohmmeter, independent of generator speed. Furnished with genuine leather carrying case, 6' test leads, 50 megographs.

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JACKSON
Porcelain Enameled
YARDLIGHTS

"Won't Blow Down" withstand wind and weather

No.
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A life-time Yardlight. Modern design—one-piece heavy gauge steel finished with three coats of Vitreous Porcelain Enamel. Completely wired and assembled. Listed by U. L.—approved for R. E. A. installation. Send for catalog.

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International Association of Electrical Inspectors—Virginia Chapter, George Mason Hotel, Alexandria, Va., May 18-19.

Materials Handling Conference and Show—Convention Hall, Philadelphia, Pa., May 18-22.

National Fire Protection Association—Annual meeting, Palmer House, Chicago, Ill., May 18-22.

Electrical Manufacturers Representatives Assn. of Michigan—Electric exhibit, Exhibition Building, Michigan State Fair Grounds, Detroit, Mich., May 19-22.

National Industrial Service Association—Annual convention, Hotel Statler, New York City, May 24-28.

National Association of Electrical Distributors—45th annual convention, Conrad Hilton Hotel, Chicago, Ill., May 24-28.

Edison Electric Institute—21st annual convention, Atlantic City, N. J., June 1-4.

Fourth National Store Modernization, Building and Maintenance Show—Madison Square Garden, New York City, June 9-12.

American Institute of Electrical Engineers—Summer general meeting, Atlantic City, N. J., June 29-July 3.

N. Y. State Electrical Contractors and Dealers, Inc. — Annual convention, Saranac Inn, Saranac Inn, N. Y., June 29-July 3.

Illuminating Engineering Society — Hotel Commodore, New York, N. Y., September 14-18.

International Association of Electrical Inspectors — 25th Jubilee meeting, Edgewater Beach Hotel, Chicago, Ill., September 21-26.

National Electronics Conference — 9th Annual conference, Hotel Sherman, Chicago, Ill., September 28-30.

Industrial Electric Exposition — Hotel William Penn, Pittsburgh, Pa., October 6-8.

Canadian Electrical Manufacturers Assn. — Annual meeting, General Brock Hotel, Niagara Falls, Ontario, Canada, September 23-25.

Second National Electrical Industries Show—Sponsored by the Eastern Electrical Wholesalers' Association, 69th Regiment Armory, 26th St. & Lexington Ave., New York, N. Y., September 29-October 2.

National Electrical Manufacturers Assn.—Haddon Hall Hotel, Atlantic City, N. J., November 9-12.

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Westinghouse Electric Corp., Pittsburgh, Pa.—Maurice H. Hobbs, assistant manager, Switchgear Division.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—L. W. Long, manager, Switchgear Department.

General Electric Co., Bridgeport, Conn.—Abe F. Warren, general manager, and Arville W. Gilmore, assistant general manager, Wiring Device Department; Frederick C. Dazley, general manager, Accessory Equipment Department; Joseph J. Lengyel, manager of marketing, Construction Materials Division.

United States Rubber Co., New York, N. Y.—Edward T. Day, manager of branch sales, and Matthew J. Delehaunty, manager of industrial sales, Mechanical Goods Division.

Corning Glass Works, Corning, N. Y.—John L. Hanigan, vice president; Dr. John F. G. Hicks, general manager, International Division.

Day-Brite Lighting, Inc., St. Louis, Mo.—O. W. Klingsick, executive vice president; James F. Whitehead, Jr., vice president in charge of sales; O. C. Klingsick, vice president in charge of operations; William S. Coffing, vice president-controller.

General Electric Co., Louisville, Ky.—Samuel E. Q. Ashley, manager, Major Appliance Division laboratory; J. Watson Dunbar, merchandising manager, Major Appliance Division; Sidney G. Stevens, manager of marketing, Specialty Refrigeration Dept.

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Holophane Co., Inc.: Daniel R. Donnelly, New York district manager, Greater Metropolitan area.

General Controls Co.: Leonard Schnall, head of new field sales and service office, Syracuse, N. Y.

Curtis Lighting, Inc.: J. V. Bradley, regional manager for the East Coast, New York office.

Westinghouse Electric Corp.: Joseph R. Kerner, distribution apparatus manager, eastern district.

General Electric Co.: Gordon R. Rahmes, district sales manager, Replacement Tube Dept. Clifton, N. J. eastern regional sales offices.

T. J. Cope, Inc.: William S. Taylor, sales engineer, Philadelphia.

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Holophane Co., Inc.: Robert W. Stanley, district manager in Connecticut and western Massachusetts.

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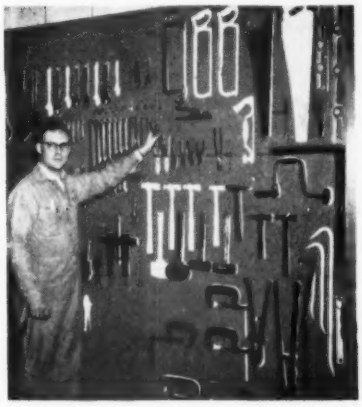

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General Electric Co.: Edward B. Weathers, manager of the Chicago District, Major Appliance Division.

Union Insulating Co.: R. L. Wildauer, district manager of the Central West, Chicago office.

Graybar Electric Co.: J. E. Carroll, district sales manager at Cincinnati; H. E. Lippert, district operating manager at Cleveland; H. M. Bridges, operating manager of the Knoxville branch.

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Graybar Electric Co.: H. E. Hanna, operating manager, Little Rock, Arkansas branch.

Buchanan Electric Products Corp.: J. E. Morton, sales representative, Fort Worth office.

Johns-Manville Corp.: W. F. Quinby, Houston region construction manager; H. P. Barnes, St. Louis region construction manager.

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General Controls Co.: Robert M. Johnson, Southern California sales manager.

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Minneapolis-Honeywell Regulator Co.: Paul Feeger, Albuquerque industrial sales engineering staff.

PLANS FOR NEW PLANTS AND EQUIPMENT

[FROM PAGE 96]

pared with $12.1 billion planned for new plant and equipment.

About 85% of the manufacturing firms report that they have a policy of spending all their depreciation allowances for plant and equipment and that they expect to continue that policy. Another 5% have been spending all their depreciation for capital goods but plan to change this policy. Presumably they feel the need to build their working capital position or pay off debt. The remaining 10% of the manufacturers have not spent all of their depreciation for plant and equipment, nor do they intend to in the future.

Depreciation reserves appear to hold up the minimum level of capital spending which businessmen say they would make even under recession conditions. The minimum capital spending businessmen report for 1954-56 is $6.0 billion a year while depreciation funds will average $7.5 billion in this period. About 80% of depreciation funds will go into plant and equipment even under adverse conditions.

We can also get some inkling of where future capital spending will be strongest from the accumulation of depreciation funds. Depreciation funds are now a fairly small proportion of present capital spending in the basic industries. The ratio of depreciation to spending is between one-third and one-half in steel, machinery, electrical machinery, automobiles, chemicals, and petroleum.

But the dollar amount of depreciation is also growing the most rapidly in these same industries. This comes about from the large investment in defense facilities needed in these industries since 1950, plus the rapid amortization of defense plants which the government allowed. The basic industries will, therefore, have large sums from depreciation becoming available in 1954-56. In steel the depreciation reserves may pile up faster than is needed to finance planned capital investment. By 1955 for instance the steel companies will have $829 million in depreciation, but their preliminary investment plans amount to only $623 million. Somewhat the same situation is true in transport equipment, engines, apparel, meat, and nonferrous metals.

The manufacturers of consumer goods, on the other hand, already have a fairly high ratio of depreciation to spending, and their depreciation funds are not increasing rapidly.

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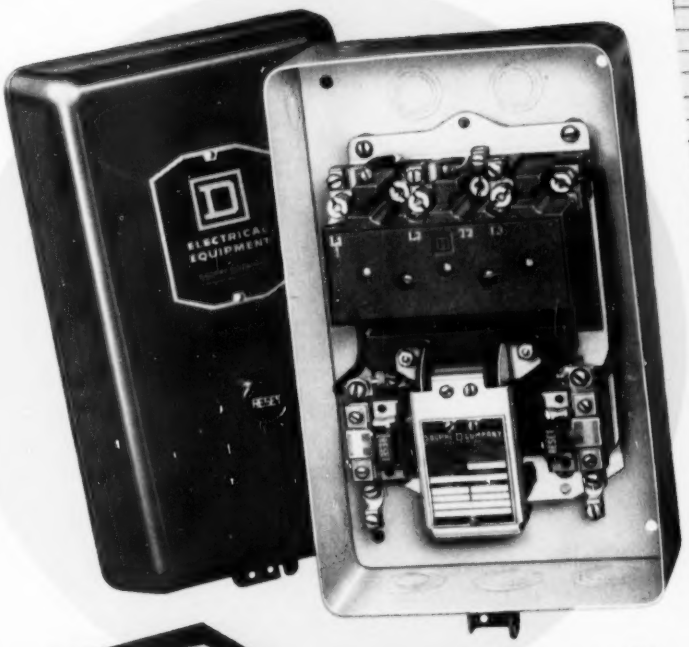

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